

COPS WEARING CAMERAS

THE NEW SURVEILLANCE TECHNOLOGY.
BUT WILL IT WORK?



PAGE 86

Popular Mechanics

HOW YOUR WORLD WORKS

42 THINGS YOU SHOULD KNOW HOW TO DO

AT EVERY AGE

LEARN FROM THE EXPERTS HOW TO:

- + HAMMER A NAIL
- + DRIVE STICK
- + PADDLE A CANOE
- + LIGHT FIREWORKS
- + THROW A PUNCH
- + READ A RIVER
- + FELL A TREE
- + SAIL, AND...

...THROW A CURVE-BALL WITH THIS GUY, REIGNING AMERICAN LEAGUE CY YOUNG AWARD WINNER COREY KLUBER



BONUS!
PULL-OUT SHOP POSTER
THE GUIDE TO
HAMMERS →

PLUS:
THE NEW
VETTE IS
AWESOME!

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THE ULTIMATE
LAWN MOWER
TEST DRIVE

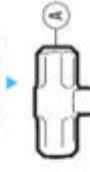
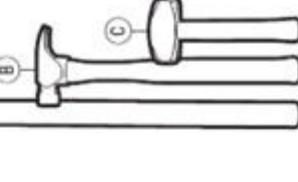
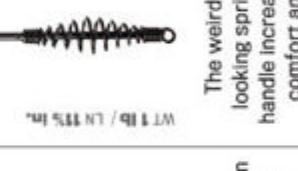
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AMERICA'S
MAGAZINE
SINCE 1902

Popular Mechanics

HAMMERS

A hammer is the simplest of tools, but it is mighty. There is a powerful inevitability to a hammer at its apex, poised in midair, an extension of your arm, milliseconds from pounding metal or stone or wood with the strength of fifty men. Once, long ago: a stone lashed to a stick. Today: all manner of specialized forged-steel heads on ergonomic handles, a hammer for every job. Use this handy workshop poster as a guide whenever you need to strike something with great force. You can do anything with the right tool, and there is no better tool than the right hammer.

TYPE	DESCRIPTION	WEIGHT / LENGTH	TOP VIEW	
			CLAW	HEAD
TRADITIONAL CURVED-CLAW	Drives nails well and removes them with the rocking action of its curved claw.	WT 0.8 lb / LN 11½ in.		
BODY MECHANIC'S	Used along with a small curved anvil called a dolly to remove dents from car panels.	WT 0.6 lb / LN 11½ in.		
LINEMAN'S	Well suited to driving big lag screws and hammering bolts in utility-pole work.	WT 2.4 lb / LN 18 in.		
CHASING	Designed to hammer and shape metal jewelry.	WT 0.4 lb / LN 10½ in.		
TITANIUM FRAMING	A titanium body with a sixteen-inch handle for maximum nail-extracting leverage.	WT 2 lb / LN 16½ in.		
SOLID-STEEL FRAMING	Its one-piece forged-steel design resists breakage, and the waffle-pattern face grips nails.	WT 2.2 lb / LN 16 in.		
WELDER'S	The weird-looking spring handle increases comfort and dissipates heat.	WT 1 lb / LN 11½ in.		



A	SELEDGEHAMMER		B	FRAMING HAMMER		C	HAND SLEDGE	
	SOFT-FACE			TOOLMAKER'S			BRICK	
	WT 2.2 lb / LN 11½ in.			WT 0.4 lb / LN 7 in.			WT 2.2 lb / LN 11½ in.	
	DRYWALL			HALF-HATCHET			HARDWOOD	
	WT 0.87 lb / LN 8 in.			WT 1.8 lb / LN 17½ in.			WT 3.2 lb / LN 16 in.	
	ELECTRICIAN'S			BUSHING			STONE	
	WT 1.8 lb / LN 14 in.			WT 3.4 lb / LN 16 in.			WT 11.2 lb / LN 34½ in.	
	PROSPECTOR'S			SLEDGE			BLACKSMITH'S	
	WT 2.0 lb / LN 12½ in.			WT 11.2 lb / LN 34½ in.			WT 7.6 lb / LN 31 in.	
	TINNER'S			STONE SLEDGE			RAILROAD-SPIKE	
	WT 1.8 lb / LN 12½ in.			WT 8.8 lb / LN 31 in.			WT 12 lb / LN 34½ in.	
	BALL-PEEN			MAUL			MAUL	
	WT 2.2 lb / LN 13½ in.			WT 1.4 lb / LN 34½ in.			WT 1.4 lb / LN 34½ in.	
	DEAD-BLOW			TACK			MAUL	
	WT 1.8 lb / LN 10½ in.			WT 1.4 lb / LN 10½ in.			WT 1.4 lb / LN 34½ in.	
	TACK			MAUL			MAUL	
	WT 0.4 lb / LN 10½ in.			WT 1.4 lb / LN 34½ in.			WT 1.4 lb / LN 34½ in.	
	PHOTOGRAPHS BY BEN GOLDSTEIN; HAMMER CREDITS, PAGE 102							

The chisel side scores a line around a brick. The hammer snaps the brick in two.

HOW TO CHANGE YOUR OIL AND BOOST YOUR CAR'S PERFORMANCE



TOOLS NEEDED



OIL FILTER CAP WRENCH
If the filter is screwed on too tightly, bust out an oil filter cap wrench. It's an attachment that you put on the end of a socket wrench.

SOCKET WRENCH SET
You'll need a socket wrench to unscrew the drain plug and maybe to unscrew the oil filter.

OIL DRAIN PAN
You could use your grandma's old lasagna tray, but a proper pan will allow for easier cleanup.

CAR JACK
Your car probably came with a jack that can give you a sufficient lift for an oil change. If not, this may be a good time to invest in one.

NEW OIL FILTER
Different cars require different sized oil filters. Check your car's owner's manual to find out what size you need.

PROTECTIVE GLOVES
Wear powder-free gloves every time and make sure to wash them after use.

THE SEVEN-STEP PROCESS

STEP 1: GATHER SUPPLIES

The first step of any job is ensuring you have the necessary supplies. Other than the aforementioned tools, make sure you have plenty of cleaning supplies for any pesky spills.

STEP 2: BE PREPARED

Before you get your car up on a jack, run the engine for a minute or so to ensure the oil is warm. You don't want the oil to be too hot, just warm enough so it thins out.

STEP 3: GET JACKED UP

For some cars you may need extra clearance. When jacking a car, be sure to follow safety procedures and only lift a car with the jack in the proper jack location.

STEP 4: DRAIN AWAY

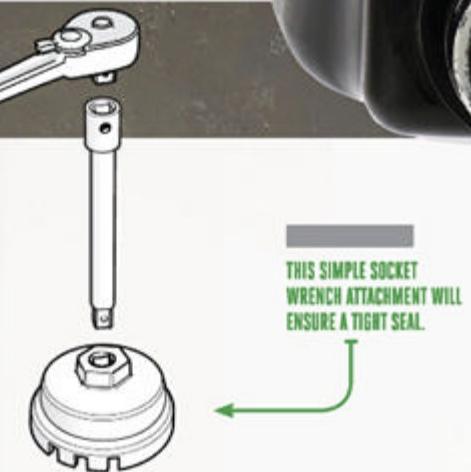
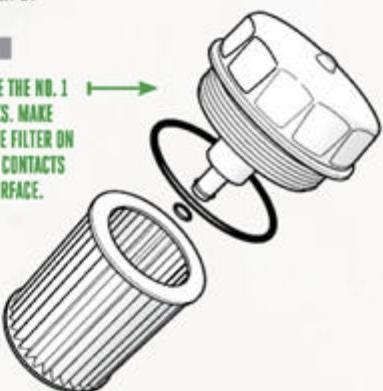
Remove the drain plug and let the oil completely drain into the drain pan. After the oil has been drained, remove the oil filter. Use your oil filter wrench to loosen the fastened filter.

A REAL GAME CHANGER

The home oil change: it's the epitome of do-it-yourself car maintenance. This quick process requires few tools and is a sure-fire way to avoid sitting around in waiting rooms. Changing your own oil also allows you to better connect with your vehicle and take control of its overall performance. And while gas may be the fuel that gets your engine going, oil is the lifeblood that keeps it moving.

Engine oil provides three key functions for your engine. First, it lubricates engine components and keeps things working smoothly. Secondly, inside of an engine there are thousands of controlled detonations happening every minute, so things can heat up pretty quickly. Oil helps transfer heat away from the combustion cycle to help keep your ride cool. Finally, oil also holds in suspension all the grimy by-products of combustion and does so while under tremendous pressure.

LOOSE FILTERS ARE THE NO. 1 CAUSE OF OIL LEAKS. MAKE SURE YOU SPIN THE FILTER ON UNTIL THE GASKET CONTACTS THE MOUNTING SURFACE.



CASTROL® EDGE® WITH FLUID TITANIUM TECHNOLOGY IS SPECIALLY PROCESSED TO DELIVER MAXIMUM PERFORMANCE FOR LUXURY CARS AS WELL AS HIGH PERFORMANCE VEHICLES, WHICH IS WHY IT'S THE OFFICIAL MOTOR OIL OF FURIOUS 7.



THE DRAIN PLUG IS A LARGE BOLT LOCATED UNDER THE OIL PAN AT THE BOTTOM OF THE ENGINE.

STEP 5: FASTEN THE FILTER

Before pouring fresh oil in, make sure to install the new oil filter. Fill the new filter three-quarters full of fresh oil before installation.

STEP 6: IN WITH THE NEW

Oil is essential to your vehicle's vitality. Castrol® EDGE®, now with Fluid Titanium Technology, is 3X stronger against viscosity breakdown than conventional and the leading synthetic oil.*

STEP 7: PROPER DISPOSAL

Make sure you dispose of the used oil in accordance with local regulations. Used oil should NEVER be dumped down a drain or in a sewer. Recycle your spent oil at an authorized auto parts store or dealership.

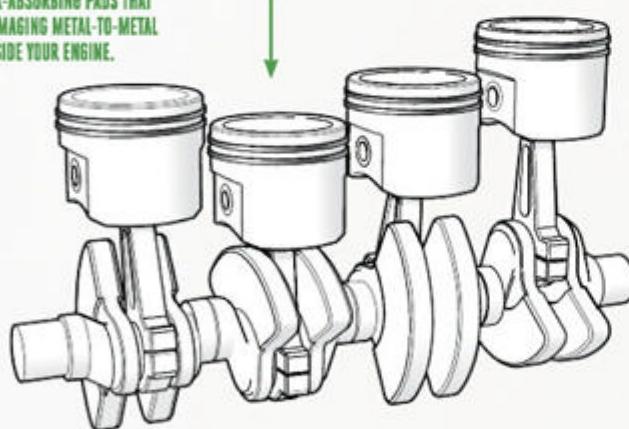
Castrol® EDGE® with Fluid Titanium Technology is 3X stronger against viscosity breakdown than conventional and the leading synthetic oil.*
*Tested in SW-30 versus all major conventional brands, Mobil 1 and Mobil 1 Extended Performance in the ASTM D5278 test.

THE CASTROL EDGE ADVANTAGE

As the automotive industry advances, the need for better fuel economy and reduced emissions, and a demand for high performance, has led to smaller yet more powerful engines. These engines work harder and at higher pressures than ever before. In the past 30 years, engine pressures have almost doubled, putting more stress on the oil. The novel Titanium FST in Castrol EDGE physically changes the way oil behaves under extreme pressures. The titanium technology in Titanium FST in Castrol EDGE is

bonded to a polymer backbone. This makes the titanium soluble in the oil, which helps it work in unison with the Fluid Strength Technology that Castrol previously pioneered in Castrol EDGE to deliver a step change in oil film strength. Castrol's advanced technology team worked with leading scientists at world-renowned academic institutions and carried out hundreds of individual car engine tests equivalent to nearly 1.9 million miles. That's almost four journeys to the moon and back.

TITANIUM FST IN CASTROL EDGE HELPS FORM SHOCK-ABSORBING PADS THAT PREVENT DAMAGING METAL-TO-METAL CONTACT INSIDE YOUR ENGINE.



Castrol EDGE is the official motor oil of Furious 7. Purchase five (5) quarts of Castrol EDGE synthetic motor oil or get an oil change using Castrol EDGE and receive two (2) movie tickets to see Furious 7. In theaters 4.3.2015 (PG-13)

AVAILABLE AT MOST MAJOR RETAILERS. GO TO CASTROLPROMOTION.COM FOR MORE INFORMATION.

FAST AND FURIOUS TIPS TO ENHANCE YOUR OIL CHANGE

1. Listen to your vehicle. Most modern cars have an oil life monitoring system that signals you when you're in need of a change.
2. There are quick release oil drain valves on the market that replace your normal drain pan bolt. These can make oil changes much more convenient and can reduce the amount of mess you make.
3. When you remove the oil filter, make sure the rubber gasket ring comes off with it. If it stays on the car, the new filter won't get a proper seal on the engine.
4. Wrap your used filter in newspaper and set it aside to take to a recycling center with your old oil.
5. When installing the new oil filter, dip your finger (while wearing gloves) in some new oil and smear it on the gasket ring of your new filter. This will help the filter seat better against the engine.
6. If your house is feline friendly, use kitty litter to clean up any oil spills. It works just as well as the oil dry the service stations use.
7. When you've finished your oil change, start the car and let it run for about 5 minutes. This allows your engine to regain proper oil pressure.

TO BE
FURIOUS
YOU NEED
TO BE
TITANIUM STRONG

BUY CASTROL® EDGE® AND GET
**MOVIE
TICKETS**

TO SEE

FURIOUS 7
4.3.2015



For maximum engine performance use Castrol EDGE synthetic motor oil, now with Fluid Titanium Technology. Buy Castrol EDGE and get two tickets to see Furious 7, in theaters April 3. Proof of purchase required. Offer expires 5.31.15. Movie ticket(s) powered by Fandango. See castrolpromotion.com for complete offer details. Castrol EDGE, the official motor oil of Furious 7.



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IT'S LIQUID ENGINEERING.*

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It shouldn't take five years to build a fire pit. But, hey, things happen.

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A wind-up dragster with CDs for wheels.

ON THE COVER:

Cleveland Indians pitcher and last year's AL Cy Young Award winner Corey Kluber, photographed at Progressive Field in January by Dylan Coulter.

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A behemoth of a grill welded in Michigan.

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- The perfect ride for a nine-person road trip.
- A harrowing tale of accident avoidance.
- How to buy your first car.



**INTRODUCING
THE FUTURE
OF TOUGH.**



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360-Degree Camera^{††} // **Remote Tailgate Release^{††}** // **THIS IS THE FUTURE OF TOUGH.**

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LETTERS

GRILLED TURKEY PERFECTION

I normally cook my turkeys over a fire pit here in Vancouver, Washington, but found out that I'd be cooking this year's Thanksgiving dinner in Dillon, Montana. The fine folks there didn't happen to have a fire pit in their yard, but the answer to my dilemma was right there in the magazine

(“Cook Thanksgiving Dinner on the Grill,” November 2014). Finding a loaner Weber Kettle was easy, but the twelve-pound bird you recommended just wasn't going to do it. To fit my twenty-five pound bird, I fashioned a shroud that fit between the kettle pot and the lid, which added an extra six inches to the inside of the grill. I kind of burnt the hell out of the turkey. I tried it again with the shroud here in Vancouver for Christmas, this time preheating the briquettes in a pan next to the grill and feeding them in as needed. Best turkey I've ever cooked. Thank you, Popular Mechanics!



DAN LINCOLN

Vancouver, Washington



UNFORTUNATELY NOT INCLUDED IN THIS MONTH'S LIFE SKILLS LIST (ON PAGE 62): HOW TO SURREPTITIOUSLY READ POPULAR MECHANICS WITHOUT ALERTING MOM

As the mother of a 14-year-old son, I wasn't too thrilled when I saw your February cover. But I thought, it's not too bad, let me see what the article entails. Lo and behold, there is a full-page picture of Olivia Munn (“The Incredibly Special Effects Awards”) with her top zipped way down and arms crossed. I'm not a super-strict mom with a broomstick stuck somewhere, but my son can't be the only young kid who gets this magazine.

SHEILA HOLZWEISS
Stamford, Connecticut

SPEAKING OF OLIVIA AND THAT ZIPPERED SUIT

It was a very real motion-capture suit, graciously provided to us by Motion Analysis Studios, whom we inadvertently neglected to acknowledge in the February issue. So, we're doing it now. Thank you.

A BENCH GRINDER REMINDER

Your Skill of the Month (“How to Use a Bench Grinder,” February) ought to include a statement about what I believe to be a serious safety hazard. The structure and composition of the grinding wheels is such that they will load up with soft metals like aluminum, brass, or bronze, meaning that the ground material adheres to the wheel instead of being cast off as dust. This can cause an imbalance-induced vibration that can lead to wheel shattering. Instead, the best tool for grinding soft metals is a bench- or pedestal-mounted sanding belt or disc.

TIM MARSH
Grand Ledge, Michigan

YOU MUST MEAN ONE OF THOSE MAGAZINES THAT ALSO COVERS SKILLED, INTELLIGENT WOMEN?

Yes, what the heck is Olivia Munn doing on the cover of the February issue? And yes, I am complaining about it! There was a woman also on the cover of the December/January issue, and now this full-page image. Please don't let Popular Mechanics turn into one of those magazines.

DURRELL STOLTZFUS
Farmville, Virginia

BUT AT LEAST THE NEW MUSTANG DOESN'T HAVE A LEGACY OF SHODDY HANDLING

You say that the new Mustang is the best yet (Cars, February), since it now has independent rear suspension and turbocharging. Well, the 50-year-old Chevy Corvair in my garage has both of those features, direct from the factory. Welcome to the twentieth century, Mustang!

FRANK BURKHARD, JR.
Boonton, New Jersey

Letters to the editor can be emailed to editor@popularmechanics.com. Include your full name and address. Letters may be edited for length and clarity. **Subscribe:** subscribe.popularmechanics.com, 800-333-4948.

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ACTUAL USER



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^Symphony Health Solutions ProVoice™ Survey, Jan. 2005-Mar. 2014. ^^Pharmacy Times Surveys, Acid Reducer/Heartburn Categories 2006–2014

**P&G Calculation based on Nielsen ScanTrack FD+, 2004–2014

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READER FORUM

PROJECT OF THE MONTH



Bending the plastic of the blade to line up with the plow's framework was the biggest challenge.

WANT SOME MONEY?

We give \$100 for reader projects that we publish, and \$50 for original reader tips that we run. You can send both to editor@popularmechanics.com.

HOW GARY ELLERTSON GOT THROUGH THE WINTER

In Kenosha, Wisconsin, the lake-effect snow can dump a foot at a time, meaning you often have to shovel snow as it's coming down. Sick of doing so and getting cold and wet in the process, Gary Ellertson, a retired hydraulic engineer, went about fashioning his own heated and enclosed plow truck. He took two rear axles off old Ford Rangers he found at the salvage yard and chopped them down to forty-eight inches (outside wheel to outside wheel) to create the plow's articulated steering. He programmed and installed the electronics and hydraulics that control the plow. And he welded the cab from four-by-eight twelve-gauge steel. The doors come off in the summer when the bed hauls fresh sod or dirt to landscaping jobs around his property. There's just one thing missing: a radio.

SOME TOOL-INSPIRED MELANCHOLY

The illustration of the spud wrench in our "Are You Handy?" quiz (November 2014) stirred up some rough memories for Ottis Berry of West Deptford, New Jersey. He credits the wrench with causing more accidents than any other tool he used while dangling forty stories up as an ironworks connector in the 1950s. He provided evidence of his past life and the despised tool.



Auto Clubs for Everyone

We put out the call for your hometown auto clubs in the first installment of "The Kids in the Garage." (Part three is on page 42.) Here's what some of the kids near you are up to after school.

AUTO CLUB	Elkhorn Area High Auto Club Elkhorn, Wis.	East Syracuse-Minoa Central High Spartan Garage East Syracuse, N.Y.	Niles West Auto Club Skokie, Ill.	Mike's Automotive at St. Helens High School St. Helens, Ore.	And One Woman Looking to Donate a Car Natalie Via of Sardinia, Ohio, has a 1970 Ford LTD with low mileage that's been in a garage for years. She wants to pass it off to a local club. Let us know if any groups around Sardinia are in the market.
RUN BY	Austin Thorson	Ryan Beckley	Tim Richmond	Mike Herdrich	
RECENT PROJECT	The club, in its garage with eight bays, three hoists, and a twenty-ton press, is currently restoring a 1970s Chevy pickup.	Fully restored and raffled off a '63 Buick Wildcat, which will pay for their next car, a '65 Mustang.	Making a 1978 Dodge Aspen race-ready for the High School division of the National Hot Rod Association Summit Racing Series.	While diagnosing and fixing cars for actual customers, the group is working on an electric-drive motorcycle.	



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CALENDAR

APRIL
2015

What our editors are doing this month. And what you ought to be.

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	
			1	2	3	4	
5	▲ Baseball's back! Opening day between the Cubs and Cardinals. Now with player tracking.	6	Time to start the yardwork. Prune away any winter wind damage to the shrubs and trees.		10	◀ Go see <i>Ex Machina</i> , the creepy British movie about artificial intelligence.	
12	► My standing Sunday appointment with <i>Game of Thrones</i> begins tonight.	13		14	Some fiction for your month: Benjamin Percy's postapocalyptic novel <i>The Dead Lands</i> comes out.	18	
19	I'll do some seasonal routine maintenance on my bike. Getting it aligned, maybe buying new tires.	20	The Boston Marathon. 30,000 people will accomplish way more than you on a Monday.	21	22	23	
26	Blow out sand and salt that accumulated in the garage over the winter with the cordless leaf blower.	27		28		30	
							
Roy Berendsohn, senior editor		Andrew Del-Colle, senior editor		Peter Martin, deputy editor		For the first time ever, I'll clean out my dishwasher's filter. Just found out it had one (see page 65).	
You		Take that bike I tuned up last weekend for the first ride of the year.		Finally install a set of venetian blinds in the kitchen that I've been meaning to get to.			

→ The Backstory: Police Across America

We dispatched photographer Christopher Griffith on a jaunt, literally across the country in five days, covering about 3,000 miles, to capture the new body

cameras and, more importantly, the law enforcement officers who are wearing them in the police departments of East Haven, Connecticut; Oakland, California;

and Ferguson, Missouri (see the full portfolio on page 86). When it came to Ferguson, Griffith says, "I was waiting for the police there to be on the defensive.

And they were categorically the opposite. Irrespective of the side of the fence you sit on with what went down there, they've been through enough that this

seemed like a safe bet. Even the police chief came down as we were photographing and was absolutely delightful. I was really surprised."

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THE PEOPLE &
THE TOOLS

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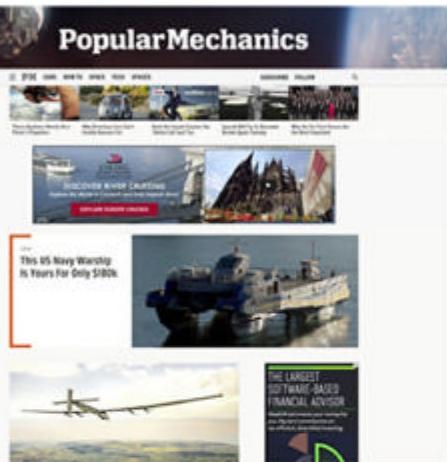
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FROM THE EDITOR

Big announcement here: Popular Mechanics has a new website, and I recommend visiting it as soon as you can. It's fantastic.

I guess technically it's not a new website—we can still be found at PopularMechanics.com, our friendly URL since 1995. But that's about all that's the same. The design is streamlined and beautiful. The news is fresh. Everything is easy to find. Our signature brand of essential instruction on everything from woodworking to robot building is more essential (and searchable) than ever. The man who can explain it best is Thomas Houston, who took over as the site's director a few months ago. He was a founding editor of the highly successful news site The Verge and is basically a digital wunderkind. I sat down with him here at the headquarters to ask what we can expect.



Ryan D'Agostino: Hey Thomas.

Thomas Houston: Hey Ryan.

RD: Tell us about this new site.

It sounds amazing.

TH: It's truly the beginning of a new era for PopularMechanics.com. The development team at Hearst has been working on a massive overhaul of all of the magazine sites, and they've built a set of tools that will let us cover breaking news and big stories alike with more speed and skill.

RD: Excellent. How will this improve the lives of our millions of readers?

TH: The site will receive updates and fixes far more often. Expect to see fresh templates and visual designs, and new ways of telling stories far more frequently. The site is going to be smarter, faster, and simply more fun as we dig into the incredible things happening in spaceflight, connected cars, connected homes, food, and science.

RD: How about old stuff? We have 113 years of fascinating information to offer.

TH: Yeah, we've spent months trawling our formidable archives, and the site is finally organized in a way that lets you go deep on anything from DIY and smart cars to phones and drones.

RD: Until now the website has been rigidly organized, which makes it difficult to place more emphasis on breaking news or seasonal DIY stories. Will that change, please?

TH: Absolutely. We have much more control over every part of the page, so we can highlight the news, features, reviews, and how-to stories that matter most now. Readers will find a dynamic site that can be rearranged on the fly depending on what's happening in the world.

RD: What's the design like? And will it look just as good on my relatively tiny phone screen?

TH: You'll notice the site is elegant, clean, and extremely fast, both on the front and back end. It's radically easier for us to edit, publish, and design stories, but it's going to be even better for our readers. The new, fully responsive site works just as well on your desktop as it does on your phone or tablet. We have access to incredible imagery, video, and, of course, our archives. The new site can finally show off the best of what we do, both in print and online.

RD: Sounds like a website worthy of being called PopularMechanics.com.

TH: Indeed it is.

RD: Thanks, Thomas.

TH: Any time.

LEGO AND THE D'AGOSTINO BOYS

To accompany Michael Paterniti's beautiful story about Lego, which begins on page 76, we asked our readers to send in pictures of their kids holding their newest Lego creations. My sons wanted in on the action. They worked on these supermachines for the better part of a very cold snow day.

Popular Mechanics

SINCE 1902

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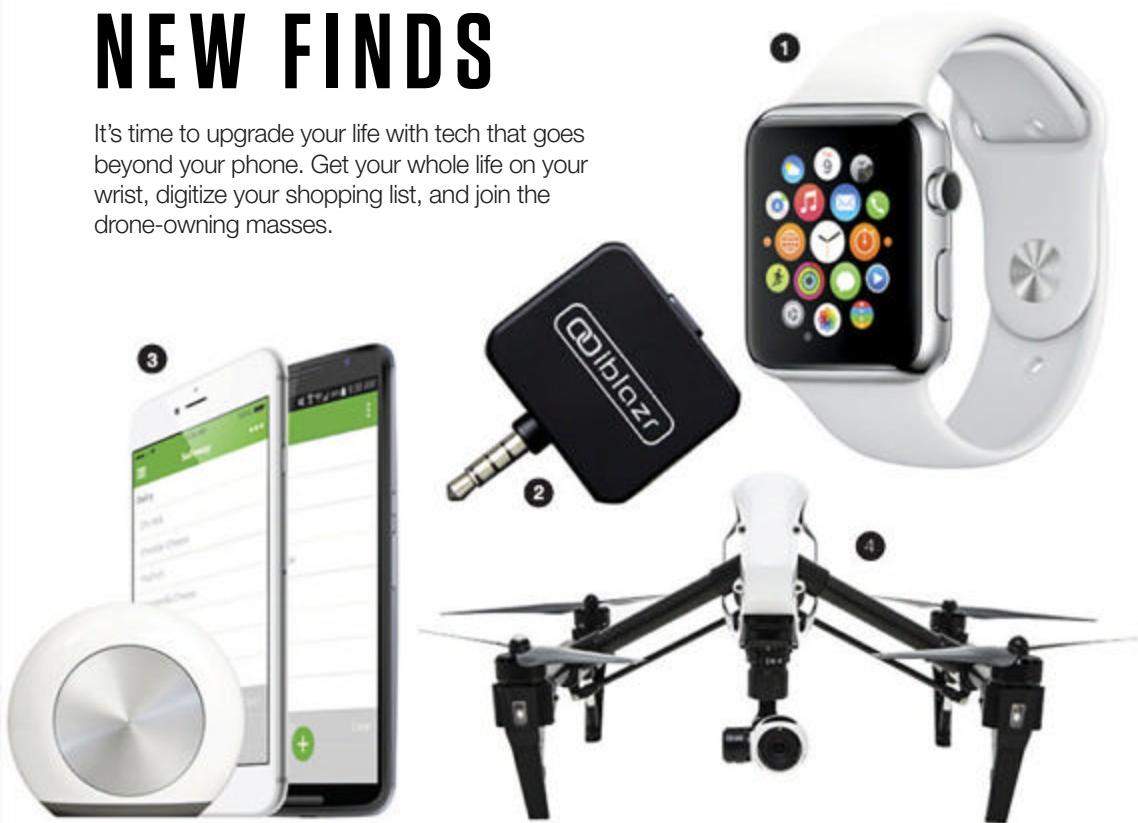
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NEW FINDS

It's time to upgrade your life with tech that goes beyond your phone. Get your whole life on your wrist, digitize your shopping list, and join the drone-owning masses.



ANDREW MOSEMAN
ONLINE EDITOR,
POPULAR MECHANICS

1. APPLE WATCH

Apple's long-awaited wearable arrives this spring with the elegance we've come to expect from Cupertino. Apple Watch's face features a minimalist take on the company's mobile operating system. Wearers will be able to check tweets, monitor their workout, or see an airline boarding pass right on their wrist.

2. IBLAZR FLASH FOR IPHONE

Smartphones now can match the performance of stand-alone cameras in many areas, but one place they fall flat is with flash. Iblazr plugs into your phone's headphone jack to deliver a more powerful burst of light than a smartphone or tablet's tiny flash could provide.

3. HIku COUNTER

Stop writing paper grocery lists and coming home to realize you forgot the milk. The handheld Hiku scans the bar codes in your kitchen and stores the items in an app on your phone, so your shopping list is always with you. It takes voice commands, too.

4. DJI INSPIRE 1

Any modern drone can shoot aerial footage. Not just any drone can shoot in ultra-high-resolution 4K video with a lens that rotates 360 degrees and tilts down 125 degrees. The Inspire 1 can even lift its carbon-fiber arms so they don't block your shots.

A MESSAGE FROM

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¹ Government 5-Star Safety Ratings are part of the National Highway Traffic Safety Administration's (NHTSA's) New Car Assessment Program (www.safercar.gov).
² Based on awards received in the past 12 months, ending December 2014.

CONTESTS!



For anyone skeptical of the hand truck's functionality, we present this photo.

THE WINNER OF THE POPULAR MECHANICS HOME WORKSHOP CHALLENGE NO. 1

By now your collective splinters should be removed, the sawdust swept up, the last bit of lacquer applied, and your plywood projects proudly at work or on display. Good job, all of you. Our first-ever Home Workshop Challenge asked you to construct something out of a single 4 x 8-foot sheet of plywood. Some people relied on CAD software, some people seemed to have no prior experience operating a saw. We were impressed by all of them. Still, there can only be one winner. And he is Mead Pelletier of Cairo, New York. He designed and crafted a heavy-lifting hand truck, wheels and all, from his sheet of plywood. We were struck by the unique, purpose-driven use of the material and the smart

interlocking joinery that makes for a sturdy truck and easy storage. Aside from the bragging rights, Mead is getting a DeWalt 108-Piece Mechanics Socket Set with which he may forever continue to innovate. You can find the complete plans to build his hand truck for yourself at popularmechanics.com/workshopwinner.

...AND THE RUNNERS-UP



Dennis Thorpe of McKinney, Texas
Thorpe's slatted bench looks like it uses much more wood, but it takes just two-thirds of a sheet of plywood. The remaining scraps can be used to make a footrest to accompany the bench.



Charlie Schreiner of Holland, Michigan
Designed to accommodate his son's six-two height and a full-size keyboard, Charlie's ergonomic standing desk allows his kid to comfortably compose music without hunching over.

Popular Mechanics

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5

1



4

The things you
need in your life
this month.

GREAT NEW STUFF



2



3

1. Keen Uneek Sandals

Made of a rubber sole and two pieces of strong and stretchy parachute cord, Uneek sandals adapt to fit the contours of any foot. No more blisters. And they're certainly breathable. \$100

2. Aerelight Table Lamp

One of the first non-TV applications of OLED technology. Tap anywhere on its aluminum body and the thin OLEDs cycle from warm

candlelight to operating-room bright. The wood base hides a wireless charger for smartphones equipped with Qi (like the Nexus 7 or LG G2) or Qi-enabled cases. \$239

3. Bang & Olufsen BeoPlay H8 Wireless Headphones

They have lightweight aluminum ear cups and soft lambskin-covered memory-foam ear pads. Touch the right ear cup to control volume, change tracks, or answer

the phone, even when you're wearing gloves. Easy. \$499

4. Osprey Atmos AG 65 Backpack

Instead of padding, this four-pound pack has a back panel made of suspended mesh that makes it feel more like the pack is floating around you, well-ventilated, and not pressing into your back. It's the most comfortable pack we've tested. \$250

5. Lenox Gold Power Arc Curved Demolition Saw Blades

These blades, for use with any reciprocating saw, have a curved shape and a titanium coating that combine to improve cutting performance and durability. We got through an entire day of demolition with them, cutting right through nails in wood, and they never snagged. \$17 for five

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HOW YOUR WORLD WORKS

THE 121-STORY TOWER THAT NEVER SWAYS

The twisted shape sheds wind, reducing its force by 24 percent.

Like most major skyscrapers built since 9/11, the Shanghai Tower has a massive, impact-proof concrete core that rises the height of the structure.

The concrete pad the building sits on is eighteen feet thick and took a fleet of trucks sixty-three hours to pour.

The tower was built with a double layer of glass that reduces heat absorption to trim cooling needs.

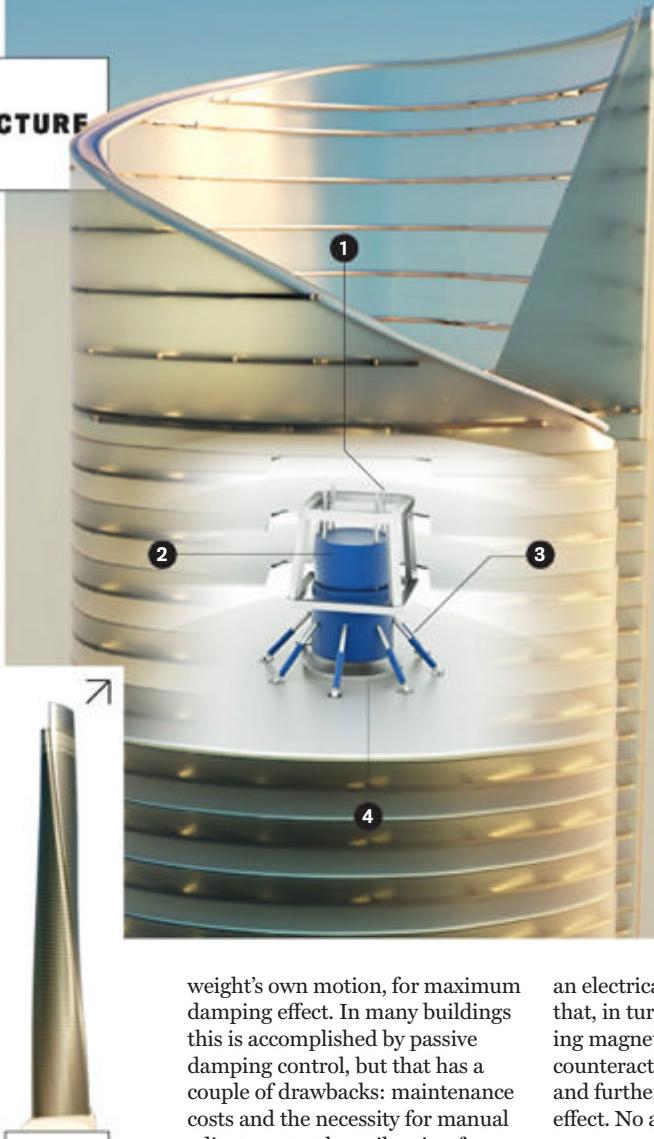
Okay, it sways, but thanks to a damping system being used in skyscrapers for the first time, no one will feel it. BY TIM HEFFERNAN

MAGINE HOLDING A YARDSTICK AT one end. When you flex your wrist even the tiniest bit, the far end of the yardstick whips back and forth. But if you hang a small weight on a spring at that far end, the weight's inertia absorbs some of the yardstick's kinetic energy and the whipping drops to a gentle sway.

Scale that up, a lot, and you have a mass damper, the system that's used to control movement in skyscrapers by reducing both the speed at which the building oscillates and the distance those oscillations cover. Mass dampers consist of large pendulums—usually steel plates bolted together to form a solid chunk—suspended from cables near the top of the building. When the building sways in a gust, the weight's inertia acts as a counterweight, pulling it in the opposite direction.

But a traditional damper wasn't good enough for the new Shanghai Tower. At 2,073 feet it's the second tallest building in the world, after the Burj Khalifa in Dubai. On the upper floors, where the flex is greatest, the oscillations would have been fast and wide enough to cause airsickness (not to mention paralyzing fear). So the building's architects and engineers came up with a solution. They installed a huge, tuned mass damper, the heaviest-ever flex-reducing weight in a building, and paired it with a magnetic system to create the first eddy-current damper used in a skyscraper.

The "tuned" in tuned mass damper refers to an additional element: a control system to limit the



HOW IT WORKS

The Shanghai Tower's enormous tuned mass damper sits just below the roof and is five stories tall.

weight's own motion, for maximum damping effect. In many buildings this is accomplished by passive damping control, but that has a couple of drawbacks: maintenance costs and the necessity for manual adjustments when vibration frequencies change. So Gensler, the architects of the Shanghai Tower, created the eddy-current damper, a masterpiece of simplicity. It consists of a 1,076-square-foot copper plate covered with 125 powerful magnets, mounted beneath the suspended mass damper. When the building sways, the 1,000-ton iron weight (360 tons heavier than in the previous largest damper) swings over the magnets, inducing

an electrical current in the plate that, in turn, creates an opposing magnetic field, automatically counteracting the weight's motion and further amplifying its damping effect. No active control or outside power source is necessary. The magnetic flip occurs because of a version of Newton's third law called Lenz's law.

The result is not just elegant engineering but measurable benefit. According to Benedict Tranel, one of the architects of the Shanghai Tower, most people will never feel the building sway, not even in summer, when the typhoons roar in.

DAMPERS
CAN GO
IN CARS TOO!
SEE PAGE
56.



DRYING OUT THE NEW WHITNEY

By the time the new Whitney Museum of American Art opens in New York City on May 1, having moved from the 1966 building that housed it for forty-eight years, its galleries will have been sitting, complete but empty, for almost four months. The issue: contaminants such as sulfur dioxide, ozone, acetic acid, and chlorides, which are all by-products of standard construction materials—and which can all cause fine art to deteriorate. To remove these gases and airborne particles, the museum's HVAC system is running specific airflow and filtering sequences for 120 days. Once particulate levels are low enough, the Whitney will bring in its permanent collection, including works by Jasper Johns, Cindy Sherman, and Mark Rothko.



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BLACKBERRY'S LAST HOPE

The three letters that could save a dying phonemaker—and turn it into a company that has nothing to do with phones at all.

BY ANDREW DEL-COLLE

WHETHER YOU BLAME corporate buffoonery or the success of Apple and Android, over the last five years BlackBerry has become essentially irrelevant to the smartphone market. But the company does have one great asset: an operating system. Although it currently contributes only minimally to BlackBerry's bottom line, this technology drives two growing markets that are about to become huge. As they do, this small asset just might become big enough to give the company a future.

Back in 2010, when it was called Research in Motion, BlackBerry bought an embedded operating system called QNX (pronounced cue-nix). Most people wouldn't know it, but QNX is all around us. It runs the computers that are used to manage railroads, all sorts of hospital equipment, huge HVAC systems, and control programs for nuclear plants. Until recently it

powered the yellow first-down line you see every time you watch a football game on TV.

But where you'll really notice QNX is in your car. Modern cars are basically giant rolling computers, and onboard software and cloud services are becoming as common as extra cup holders. QNX dominates the automotive market, with clients including Volkswagen, General Motors, and Hyundai. Altogether, more than forty carmakers use the operating system to run their infotainment screens, navigation, digital instrument clusters, and even the electronic safety systems that will allow cars to operate without drivers.

The appeal has to do with QNX's diagnostic services and flexible architecture. It's a microkernel-based operating system, which QNX compares to a string of Christmas lights that have been set up in a parallel circuit rather than in series. Unlike traditional OSes (and Christmas lights), if one

piece of code fails, the entire system doesn't crash. This makes finding and fixing software errors much more simple and allows QNX to more efficiently handle the staggering number of processing duties in a modern vehicle. It's more effective than the standard (and monolithic) kernel operating system, such as Microsoft's automotive platform, which is why Ford announced last year it would be ending its eight-year relationship with Microsoft and switching to QNX. Another big QNX advantage: It works with both Apple and Google's in-car systems, CarPlay and Android Auto.

If in-vehicle success were not enough, BlackBerry recently announced BlackBerry IoT, its own cloud-based network for the Internet of things—a nascent and prosperous potential market. With QNX's history and BlackBerry's reputation for security, it could be another huge opportunity. But first, BlackBerry has to leave its phones behind. Most people already have.

A TROUBLING OBSERVATION: PEAK DVR IS UPON US



With its twenty-four-terabyte hard drive, the new TiVo Mega DVR (\$5,000) holds 26,000 hours of standard-definition TV (4,000 hours in HD), which can be good news only for companies that treat bed sores or make elastic waistbands. To those conspiring to further enable our couch habits: You can make our TVs bigger and better, but we're fine with the DVRs we have. Even if they can't record three years of prime time.

A LESSON IN DURATION





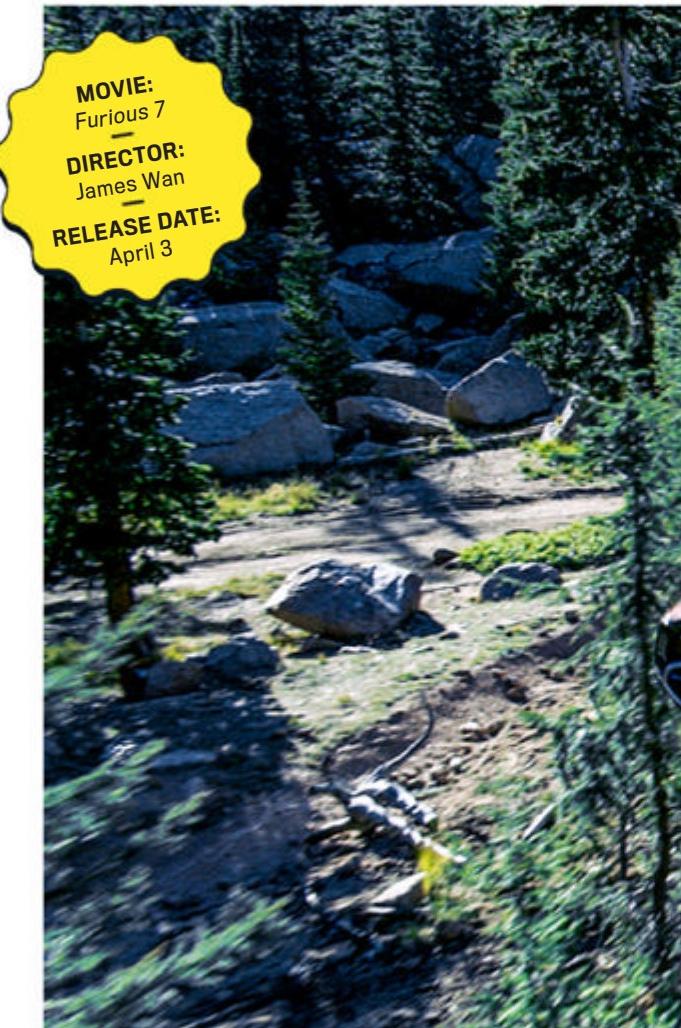
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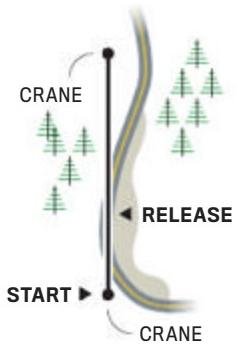
HOW'D THEY GET THAT SHOT?



WIRING

In this scene Vin Diesel and his crew of affable criminal grease monkeys are chasing a bus with valuable cargo. The bus is racing down a secluded road, so they've just parachuted their cars out of a plane to catch up to it. (Obviously.) To get forward movement in the car, we brought in two 300-ton cranes, one at the top of the road and the other at the bottom. They had one-inch rope strung between them.

The car is on a skate and hanging on that rope. At the start mark it was forty to sixty feet off the ground.



We asked two of the people most responsible for the action in the seventh installment of the Fast & Furious franchise—second unit director Spiro Razatos and second unit stunt coordinator Andy Gill—to walk us through a particularly tough but amazing shot.

ALTITUDE

The high altitude at Colorado's Pikes Peak—the summit is 14,115 feet, and this scene was shot at 12,000 feet—was tough on the crew in terms of breathing but also tough on the cars. **At 10,000 feet you lose 30 percent of your horsepower,** and it keeps dropping from there. The lack of oxygen interferes with the combustion process.

THE CAR

This 1970 Dodge Charger is hand-built. **The only stock parts are the roof and the tops of the quarter-panels**, and even those are fabricated a bit, adjusted to fit. It has a tube-framed chassis similar to a Pro 2 truck's, King coil-over and bypass shocks, and an independent front suspension. The 520-horsepower LS3 motor was moved back to shift the center of gravity to handle the jumps.

ENVIRONMENT

The right side of the road was a dirt lane and a culvert, so the crew brought in their own rocks, along with trees up to twenty-five feet high mounted on a steel pallet.



SPEED

The parachuted car fell at twenty-five miles per hour. Once it reached that speed on the rope, the car was dropped from eight feet up—as high as possible without causing damage.



LOCATION

The road is a section of Pikes Peak Highway, which we were allowed to close down for eight days. The rest of the time we filmed in fifteen- to twenty-minute increments while a **line of traffic formed behind us. Some of the people waiting—especially the cyclists—made it clear they were unhappy with the delay.**

DIGITAL EFFECTS

We didn't want to do these scenes in CGI. We wanted them real. **(We even dropped real cars from the airplane to set up this shot.)** The only CGI was painting out the overhead and pullback wires and adding in a parachute.

DROP POINT

The parachute lines are actually CGI to cover the cables suspending the car. They're attached by steel pick points welded into the roll cage. **The driver hits a release inside the car to trigger explosive cable cutters.**

THE DROP

With the car suspended on the cable, the driver would give a thumbs-up and start the engine. We'd count down: "3-2-1-drop." He would start out in neutral, and as he got close he'd put the car in gear, then throttle up a little. When he got to his mark, he'd hit the release button and hammer the gas pedal so the car would peel out when it hit the road. It was actually less of a peel-out than we'd hoped for.

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/ FIND NEW ROADS™

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THE ASTRONAUT SWEATER

This new sweater uses NASA technology to adapt to your body temperature. And it's stylish, too.

BY SARAH Z. WEXLER

SPRING IS TRICKY. IT'S COLD, THEN IT'S HOT, THEN it's cold again. It's annoying. And it means you need a sweater. But what would really be great is a sweater that uses the same technology that's been protecting astronauts for twenty-five years.

Gihan Amarasinghe, who trained as an engineer at Massachusetts Institute of Technology, partnered with two students at the business school to launch an online clothing company, Ministry of Supply, in 2012. (The first permanent physical store opened in 2014 in Boston.) Their goal was to combine the technology of athletic gear with the style of dress clothes. At first this meant using moisture-wicking, stretchable fabric to make button-downs, but then the company incorporated phase-change materials, which were used in textiles by NASA to regulate the temperature inside a spacesuit. (If an astronaut faces the sun with his back to deep space, the temperature difference on the opposing sides of his spacesuit can be as high as 275 degrees Celsius.) This year Ministry of Supply unveiled its first thermoregulatory sweater, the Mercury (\$168).

Here's how the technology works in regular gravity: The sweater is made of moisture-wicking merino wool blended with acrylic. Each fiber is embedded with a tiny amount of paraffin wax, which freezes or melts in response to its surroundings. As you overheat, the wax melts, turning from a solid into a liquid, kind of like a candle, and drawing out excess body heat to cool you off. When you get cold, the reverse happens. The wax freezes into a



solid, causing it to release the stored heat back to you. The full process—in either direction—takes about seven minutes and is much easier than opening a window. And it does all this while still managing to feel as comfortable as a typical sweater.

Amarasinghe also paid extra attention to the body's hot spots. Using infrared thermography, he mapped the key areas that expel heat (no surprise: your armpits) and cooled them by adding six ventilation holes to reduce fabric density by 25 percent. Instead of sewing in these panels separately, Amarasinghe has them made with 3D robotic knitting, like 3D printing for clothing. The machine prints out the sweater in panels and tubes that it links together as it works. The sweater comes out of the machine as one seamless garment, thereby avoiding any additional itchiness or annoyance. Scott Kelly wouldn't tolerate either of those things. And neither should you.

The new Fjällräven Duffel No. 6. (The j is silent. So are the umlauts.)



ADD YOUR OWN WAX

A good duffel needs to be tough. Fjällräven, the Swedish outdoor company, just introduced a new bag—it's first to fully convert into a backpack, with straps that hide inside the bag until you need them. The Duffel No. 6 (starting at \$200 for a fifty-liter bag, which is plenty of space to get you through a weekend) is already durable and water-resistant, since it's made out of a cotton-polyester blend impregnated with paraffin and beeswax. But the bag can be even tougher, as long as you're willing to put in a little work. For an extra \$10 you can pick up your own bar of Fjällräven's homemade Greenland wax. Rub on as much as you want, iron it in, and your duffel becomes practically indestructible. If you change your mind, you can remove the extra wax by running the bag through the laundry. But why would you?

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HOW HIGH UP CAN I GET WITH A LAWN CHAIR AND BALLOONS?

A YOU REFER, OF COURSE, TO THE ENDEAVOR KNOWN FORMALLY as cluster ballooning, in which some yahoo (or, these days, maybe actually a trained pilot) slips the surly bonds of earth in a manner pioneered by the storied aviator Curious George. As that good little monkey and his followers have discovered, grab hold of enough helium balloons and it's up, up, and away. How far up? A couple of folks have topped 20,000 feet, a full-on airliner altitude requiring both Federal Aviation Administration permission and the use of supplemental oxygen.

Some argue that the modern practice of cluster ballooning traces its roots not to Curious George but to "Lawn Chair Larry" Walters, a California truck driver who, one day in 1982, outfitted a standard-issue patio chair with a few dozen helium-filled weather balloons. What happened was he zoomed up to 16,000 feet, drifted into controlled airspace, and, after taking out a few balloons with a pellet gun, ultimately crashed into some power lines, causing a blackout in Long Beach. So, in other words, big success.

Do you have unusual questions about how things work and why stuff happens? This is the place to ask them. Don't be afraid. Nobody will laugh at you here. Email greatunknowns@popularmechanics.com. Questions will be selected based on quality or at our whim.

The "sport" has come a long way since. The two marquee names in cluster ballooning these days are John Ninomiya and Jonathan Trappe. Ninomiya has more than twenty years' experience flying conventional hot-air balloons, and the license and certification to back it up. Trappe, too, is an FAA-certified pilot with a specific rating for ballooning. Typically they operate with full ground crews, who help inflate between fifty and 150 beefy, oversize helium balloons, spot for the pilot while he's airborne, and position themselves to assist in a safe landing. These legit pilots know the rules and how to control their improvised aircraft—and they do not take flight in or on patio loungers, La-Z-Boys, futons, ottomans, gout stools, chaise longues, fainting couches, davenport, Eames chairs, or other household furnishings.

Would an ant be able to survive a fall from the top of a tall building?

Yes, ants could survive falls from tall buildings. They could also safely plunge from soaring Barcaloungers, making them perfect pets for cluster balloonists.

When anything—an ant, a bowling ball, a truck driver—falls from a decent height, two opposing forces act upon it. Gravity pulls the object toward the ground. Air resistance, meanwhile, pushes in the opposite direction. As something begins to fall, it picks up speed, but as speed increases, so does air resistance. Eventually the two forces reach a stalemate in which the object stops accelerating and falls at a steady rate, known as terminal velocity.

The key is that the pull of gravity is based on mass, while air resistance is based on surface area (think of a parachute). Therefore, if the relationship of these two factors is sufficiently favorable, as it would be with a very light object such as an ant, the terminal velocity will be quite modest, meaning the ant won't hit the sidewalk hard enough to injure itself.

Is it true that dogs are colorblind? How do we know what something looks like to an animal?

It is true that dogs make terrible interior decorators, but, contrary to popular belief, that's not because they're colorblind. In fact, dogs can see colors, just not as many as we can. Humans have three types of color-sensing cone cells in their eyes, while dogs have only two. The result is similar to red-green colorblindness in humans, not a world in stark black and white. Fact is, color isn't especially important to dogs, who rely far more on their sense of smell to discern the difference between fresh dog food and that old dead mouse in the basement immediately prior to enthusiastically eating them both.

How do we know what animals see? Brave scientists have volunteered to surgically swap eyeballs with a variety of . . . Actually, it's much simpler than that. There are two questions researchers must answer: First, what is the animal physiologically capable of seeing? Second, how does the animal perceive it? The former question is settled by DNA analysis, which detects genes related to color sensing, combined with the use of an instrument that measures the wavelengths an animal's eye absorbs. The latter issue is attacked by means of behavioral testing: A dog may be trained to respond to certain colors by rewarding it with treats. Of course, a dog could likely be trained to operate a locomotive if enough treats were at stake.

As animal vision goes, dogs are fairly dull. Honeybees, for instance, use the polarization of light in the sky to navigate. And don't get us started on the mantis shrimp, the most common of which has at least sixteen types of photoreceptors in its visual system, making it the most complex known, and meaning that when the inevitable oceanic uprising comes, there will be no hiding from the unremitting onslaught of the mantis shrimp. You have been warned.

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hands. Turn the watch over and examine the 27-jeweled automatic movement through the exhibition back. When we took the watch to George Thomas (the most renowned watchmaker and watch historian in America), he disassembled the *Magnificat II* and estimated that this fine timepiece would cost over \$2,500. We all smiled and told him that the Stauer price was less than \$90. He was stunned.

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SKILLS



HOW TO DRIVE ANYTHING

Found a dangerous piece of heavy machinery with the keys in the ignition? Here's what to do next.

BY ALEXANDER GEORGE

YOU GET THE FEELING WHEN YOU WALK BY A CONSTRUCTION SITE. WHAT WOULD IT BE LIKE TO hop up in the chair and drive the backhoe, move around some gravel? All those levers. What do they do? Maybe you're momentarily imagining saving the day, and that empty tower crane would be the perfect tool for rescuing a busload of orphans. But you don't know how to drive a crane!

You could read the instruction manual, but the orphans don't have that kind of time. That's why we pulled together these instructions. They're not enough for a certification, and the professionals would probably call the authorities if you tried any of this without permission, but when you have ten minutes to foil the plans of nefarious evildoers (or, you know, to move some pallets around the backyard), you'll be glad you know what to do.

INSIDE:

A LIBRARY OF TOOLS PAGE 36

• WHAT'S INSIDE A TUBE AMP PAGE 38

• A DISHWASHER THAT SMOKE CHEESE PAGE 40

SKILLS

VEHICLES

ACTION
HERO
BONUS!

Most cranes max out at about 0.6 revolutions per minute, but at that speed a bad guy at the end of the boom will be moving at over thirty miles per hour, which should be enough to fling him to oblivion.

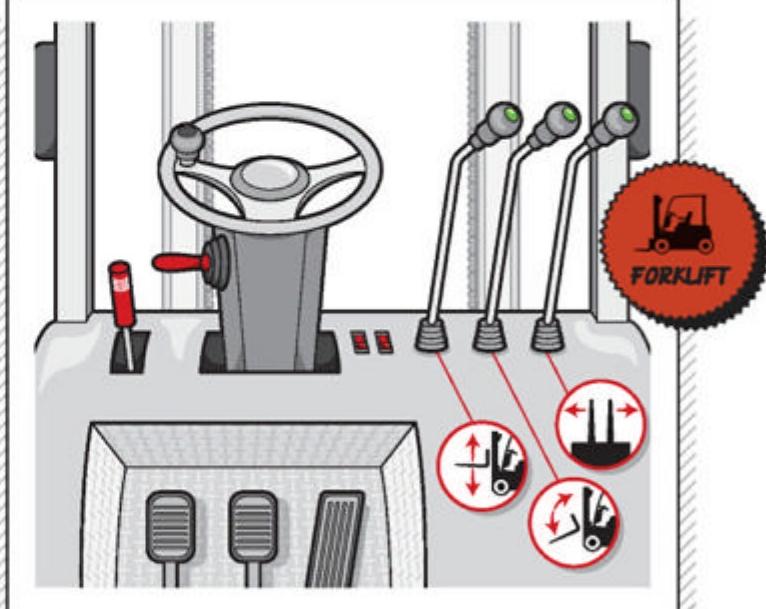
Liebherr 316 EC-H Litronic Hammerhead



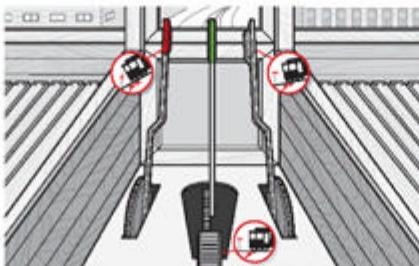
- 1 Turn the red rotary switch on the back wall to start the power. Now find the control-on button on the panel. Press it and a green indicator light will start flashing. The joysticks have induction sensors and will work only when they're in your hands.
- 2 The right handle controls the hook's vertical movement. Move it forward to lower the cable holding the hook. Pull it backward to raise it. Press the thumb button to raise the cable at an extremely slow speed. If the crane is on tracks, moving the stick right or left will drive the whole rig.
- 3 The handle on the left-hand side moves the hook toward or away from you along the boom. Tilt the stick forward to push the hook away, pull it toward you to bring it back. Tilt the same stick to the left to swing the whole crane left and vice versa.

Toyota 8-Series Internal Combustion

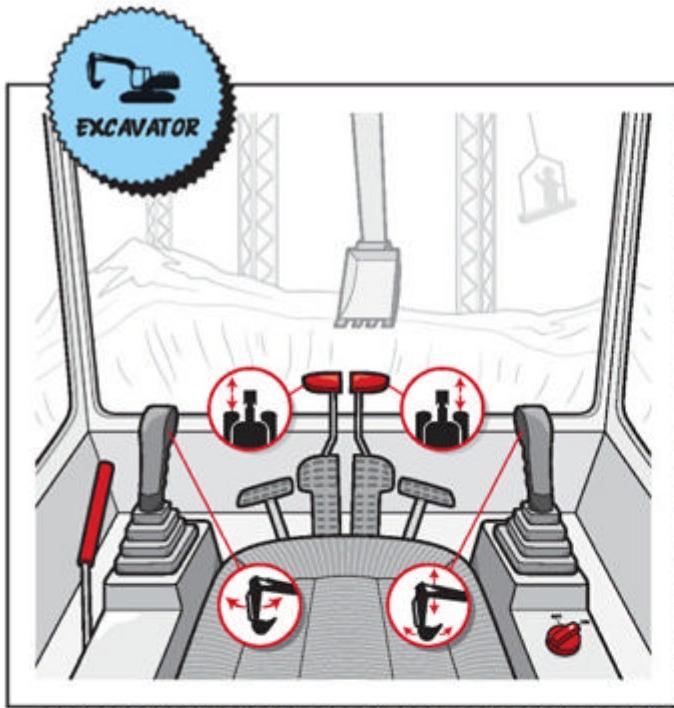
- 1 The controls are like a car's: The right pedal is the throttle, or accelerator, and the middle pedal is the brake. Depress the far left pedal and the accelerator to make the forklift creep forward slowly. The lever to the left is the emergency brake. Whenever you leave the seat, pull the brake toward you to engage it.
- 2 Fasten your seat belt. Forklifts can tip, so the rear is usually weighted down with cast iron for balance. Forklifts are heavier than they look.
- 3 The direction-selector stalk is on the left side of the steering column. Push it forward to go forward, to the middle to put it into neutral, and toward you for reverse.
- 4 On your right, the lever closest to you controls the forks. Pull back to raise them, push forward to lower. The next lever adjusts the tilt of the forks so you can get underneath loads. If your forklift has a third lever, it will adjust the width of the forks for different loads. To lift a standard pallet, position the forks about one inch off the ground, level or at a slightly forward tilt.



CABLE CAR
Double-Ended California Model



- 1 These cars move by gripping a cable under the street that is traveling at 9.5 miles per hour. The lever in the middle of the operator's area engages the grip, which tightens around the cable and drags the car along.
- 2 Before the grip operator does anything, someone has to step out into the street and pull the lever for the "gypsy," which lifts the cable to the surface so the grip can reach it. Now pull the grip lever toward the rear

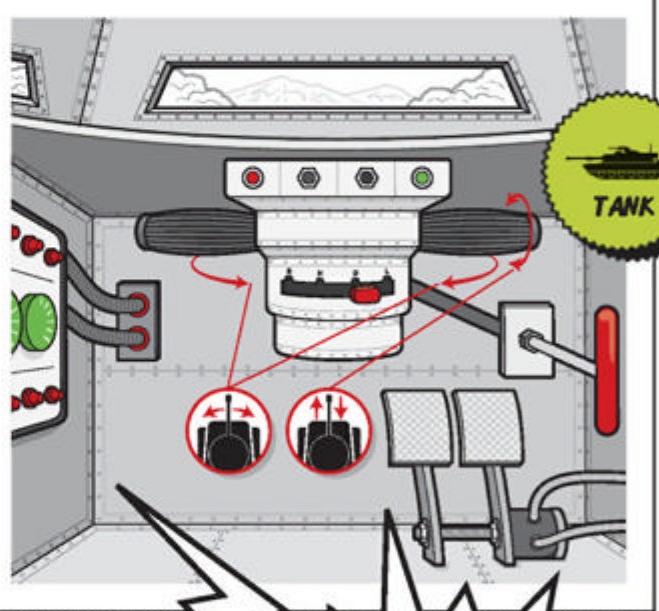


John Deere 210G LC

- 1 On the right armrest is the ignition knob. Turn it all the way to the right and hold it to start the engine. Look for a lever with a red tip to the left of the seat. When that's raised, nothing works, so lower it when you're ready.
- 2 The pedals and the levers attached to them control the tracks that move the excavator. Push the left handle/pedal forward to move the left track forward or pull it back to reverse it. Same with the right. Push forward on the outside track's pedal to turn. Use the handles when you need to be precise, like when driving onto a trailer.
- 3 If the excavator were an arm, the right stick controls what would be its biceps, the boom. Pull it toward you and the boom goes up. Push it forward, it goes down. Push the same stick to the left to make the bucket (the hand) curl in. Push it to the right and it will empty its contents.
- 4 The left stick works the forearm of the excavator. Pull the stick toward you and the arm swings toward you. Push it away and the arm moves away. Push this stick left or right to rotate the cab on top of the tracks.

M1A1 Abrams

- 1 Enter through the circular hatch and move into the seat deep in the hull. Press the master power switch, then hold the starting switch for several seconds to start the engine. Both are clearly labeled. The left panel is the dashboard with revolutions per minute and fluid levels.
- 2 Press the left pedal to engage the brakes, then pull the chest-level lever on your right side to release the emergency brake.
- 3 The knob in the center of the T-bar in front of you selects the gear for the automatic transmission. Slide this knob to D to put the tank in drive. To move, twist either handle on the bar toward you, as you would on a motorcycle. Twist it more to go faster, but be careful! The throttle is sensitive.
- 4 To steer, pull the left handle toward you to turn left and the right handle toward you to go right. The inputs are sensitive, so be prepared to turn hard.



of the car. To accelerate smoothly, do this slowly while releasing the brake pedal.

- 3 To halt the car, gently release the main grip lever and apply the foot-pedal brakes, which are regular

steel brake shoes that grip the wheels, or the track brake, which is the tallest lever on the right. The track brake is a set of arms made of pine or fir beams that presses against the track and stops the car with friction.

A third option is to apply the slot brake, which is the red lever to the left. It sends a sixteen-inch steel wedge down to the cable slot. It's single-use, so only pull the leftmost lever if the other brakes fail.

ACTION HERO BONUS!

The top speed is a governed forty-two miles per hour. Tanks are not good for fast getaways.

SKILLS

TOOL TEST

BEST OVERALL

HERE COME THE HEDGE TRIMMERS

Four new machines take on the yard from hell. **BY ROY BERENDSOHN**

THIS TEST WAS A BEAST. ON A BLAZING-HOT DAY, we took four cordless hedge trimmers to a large group of yews and boxwoods and a hedge that was about 8 feet tall, 6 feet wide, and 60 feet long. There were saplings growing in the middle of this thing, plus vines and thorns. Trimming it required a ladder and odd positioning, twisting and turning on the part of the testers. One editor was almost laid out by poison ivy. So we know these rankings are legitimate—all four trimmers went through the toughest obstacle course around.

STIHL HSA 66 \$630



Battery: 36-v/4.5-Ah Li-ion
Blade length: 22½ in.

Likes: Some years ago we gave Stihl a Breakthrough Award for its cordless-tool platform. That decision was based on the strength and performance of this product's predecessor, which we continue to stand by. This machine is a brute. It comes as close to gas-engine performance as any cordless tool can. It cuts with a vengeance, and it's got incredible longevity. You'll get tired before this trimmer will.

Dislikes: It is awfully heavy. There's no getting around that. But if you want real equipment, there are some necessary tradeoffs.



EGO HT2401 \$200



Battery: 56-v/2-Ah Li-ion

Blade length: 25½ in.

Likes: Before this test, we'd have said that Stihl was king of the cordless outdoor power tools. But the competition is closing in. The Ego cruised through thick and thin branches alike, and it was the most well-balanced.

Dislikes: It's got as much power as the Stihl, but not quite the same run time. And it's almost two pounds heavier.



BLACK & DECKER LHT2436 \$130



Battery: 40-v/1.4-Ah Li-ion

Blade length: 24 in.

Likes: The smallest of the trimmers is extremely nimble, but it still worked nicely on the overgrown boxwoods. We liked its easy-to-use safety feature: a thumb latch that must be held back for the trimmer to work.

Dislikes: It's no match for really tough trimming. Also, its reciprocating action coasts to a stop. Instant stop is safer.



RYOBI RY40601A \$270

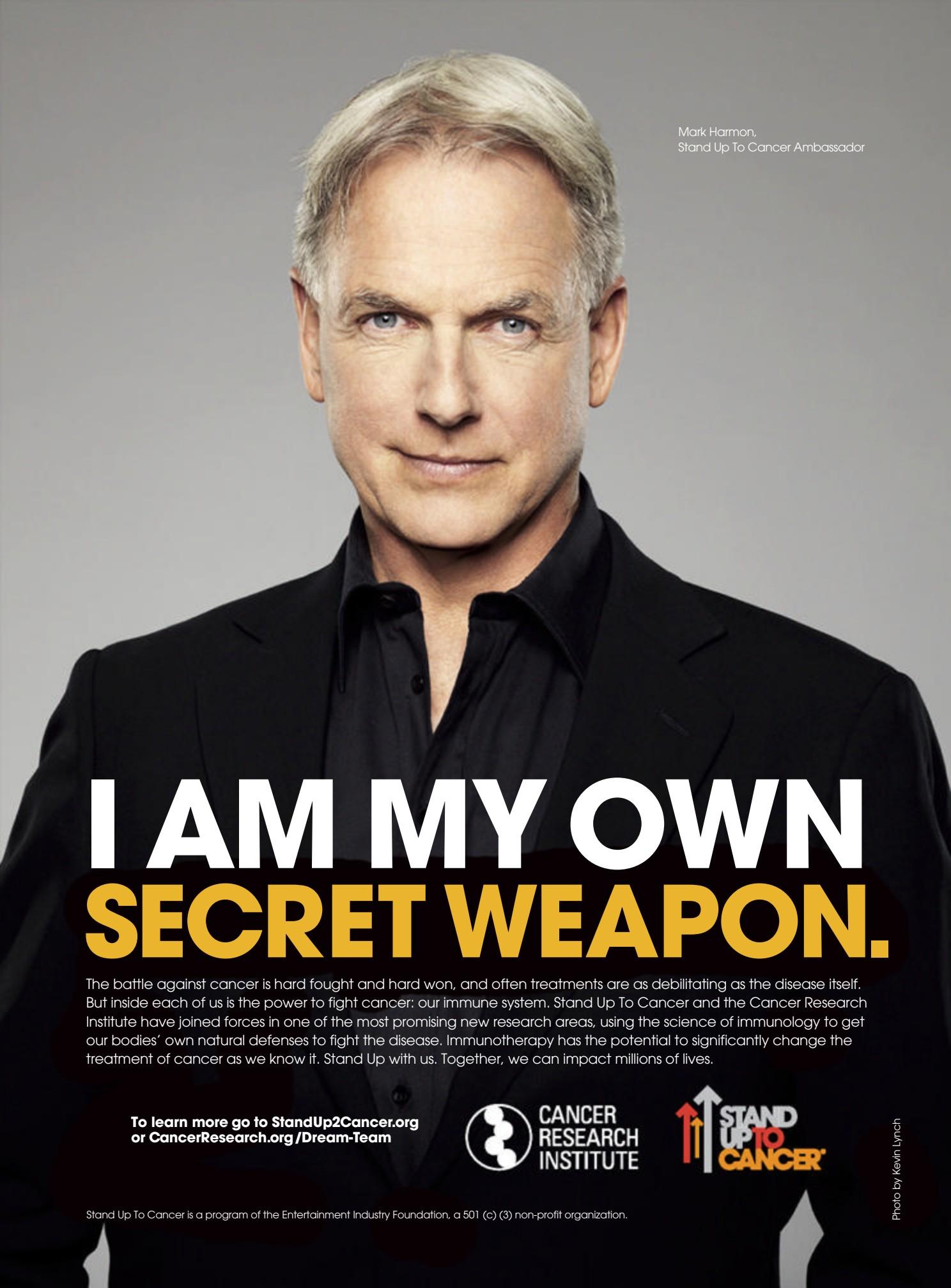


Battery: 40-v/2.35-Ah Li-ion

Blade length: 25½ in.

Likes: This is a good tool. It will handle all but the most ornery shrubs. Its large handles and gigantic trigger work particularly well if you're wearing gloves.

Dislikes: Mounting a gigantic battery high on the tool throws off its balance, and that's a problem with all the twisting you have to do while shearing. It's best for standard, cube-shaped shrubs.

A professional headshot of actor Mark Harmon. He has short, light-colored hair and is wearing a dark, button-down shirt. He is looking directly at the camera with a slight smile.

Mark Harmon,
Stand Up To Cancer Ambassador

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The battle against cancer is hard fought and hard won, and often treatments are as debilitating as the disease itself. But inside each of us is the power to fight cancer: our immune system. Stand Up To Cancer and the Cancer Research Institute have joined forces in one of the most promising new research areas, using the science of immunology to get our bodies' own natural defenses to fight the disease. Immunotherapy has the potential to significantly change the treatment of cancer as we know it. Stand Up with us. Together, we can impact millions of lives.

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Stand Up To Cancer is a program of the Entertainment Industry Foundation, a 501 (c) (3) non-profit organization.

SKILLS

TOOLS



THE BORROWING PLACE

A library. Of tools. What a great idea.
BY FRANCINE MAROUKIAN

WE HAVE LIBRARIES BECAUSE THE ANCIENT Greeks believed that making the collected wisdom of mankind available to all was good for society. Know what else is good for society? Building stuff. So consider the West Philly Tool Library a key to humankind's shared history of know-how: a warehouse of 4,200 tools—hammers, screwdrivers, lawn mowers, rakes, drywall lifts, miniature concrete mixers—that visitors can take home without buying.

Located in an economically diverse neighborhood known for its affordable stock of Victorian-era row homes that seem to be in constant need of repair, the library has attracted borrowers of all socioeconomic statuses since opening in 2007. Some of the 1,800 members pay the \$400 lifetime fee; others opt for an annual \$20 to \$50, on a sliding, income-based scale. (The rest of the cost is shouldered by local organizations, businesses, and universities.) In exchange, members can borrow as many tools as necessary for up to a week at a time.

With such a low barrier to entry, as well as

↑ Ben White, one of the West Philly Tool Library's board members, looks for a taping knife for a drywall patching job in his kitchen.

knowledgeable tool librarians, a tool mechanic, and some 150 reference books, the library offers its members the opportunity to tackle otherwise insurmountable projects with little more than a can-do spirit. "Let's say you're hanging lots of trim or framing, or putting down flooring. A pneumatic nailer is pretty much a must," says Peter Foreman-Murray, the library's executive director. "But most people don't have one, and won't use it more than once or twice. That's exactly the kind of tool for which the tool library exists."

Other reasons why the library exists include community projects, such as the 3,268-square-foot playground at Park Lane Elementary School, in nearby Darby, that went up last summer. Before construction started, a crew of volunteers (and former NFL quarterback Ron Jaworski) cleared the tool library clean out of wheelbarrows. Other peak periods: September, when students at nearby University of Pennsylvania, in a hurry to install dorm-room shelves, snatch up the cordless drills. In the spring, the string trimmers depart in flocks. And masonry tools are in constant demand for fixing up Philadelphia's aging buildings. As in a regular library, you can see the life of the community written in the tools it borrows.

PEOPLE AT HARDWARE STORES

We stopped shop-
pers outside Intown

Ace Hardware
store in Decatur,
Georgia, and asked
them what they
had bought.



SHELTON DAVIS

"We have pests in
the basement, so we
came to get chicken
wire, mousetraps,
and spray foam to
persuade them to go
elsewhere."



PATRICK GARMAN

"Latex paint and
plaster of Paris to
mix for a nice, chalky
finish. Apparently
it's all the rage in
designer magazines
right now."



IAN FLOWERS

"I'm staying at my
cousin's house,
and he has old
toilet seats that keep
breaking. I
stopped in to get a
replacement."

PHOTOGRAPHS BY SARAH SHATZ (LIBRARY),
MARK HILL (SHOPPERS)

Popular Mechanics

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SKILLS

THINGS COME APART
WITH TODD McLELLAN*

THIS IS WHAT ROCK AND ROLL LOOKS LIKE

A Fender '65 Princeton Reverb tube amp, deconstructed.



A GUITAR AMPLIFIER IS AN ELECTRONIC DEVICE THAT TRANSFORMS A BOARD AND SIX STRINGS INTO A furious agent of cultural change. The amps most coveted by guitarists do this with vacuum tubes. These archaic bits of technology heat electrodes in evacuated glass chambers, amplifying an electric guitar's signal while also introducing much-desired distortion. Give a vacuum tube too much power and the sound it produces starts to break apart. The sunny hum of a plucked string becomes a raspy howl. This is the essence of rock and roll. When the invention of semiconductors made it possible to use more durable parts to amplify sound cheaply, guitarists wanted none of it. They stood by their tubes.

To show you where all that classic sound comes from, we got our hands on Fender's '65 Princeton Reverb amp. Like rock stars, we smashed it. Then we got Chicago Amp Works technician Patrick McKeever, who counts Wilco and Red Hot Chili Peppers as clients, to explain the parts. — KEVIN DUPZYK

A GLOSSARY OF CLASSIC ROCK

You can hear the Fender amp's bright sound best on songs like "Not Fade Away" by the Crickets. Here's where you'll find a few of the other effects we mention.

DISTORTION

"Maybellene"
by Chuck Berry

REVERB

"Rumble"
by Link Wray and His Ray Men

TREMOLO

"Gimme Shelter"
by the Rolling Stones

① **CABINET:** The box that holds everything. This one is made of pine.

② **MAIN CIRCUIT BOARD:** Connects all the amp's components, including the vibrato circuit, which varies the current in the power tubes to temporarily lower the power and create "vibrato." (Technically this is "tremolo," but Fender confused the terms in the 1950s and it stuck).

③ **SKIRTED KNOBS:** Sadly, these only go to 10.

④ **5AR4 RECTIFIER TUBE:** Converts AC electricity from the power transformer to DC. Rectifier tubes lose power when subjected to a lot of current—which tends to happen when a guitar is played hard and loud. This sag causes audio to break up, a trademark of the tube-amp sound.

⑤ **6V6GT POWER TUBES:** The last section the signal passes through before the speaker, these crank up the audio signal.

⑥ **PREAMP TUBES:** Increase the amplitude of the audio signal from the guitar and send it to circuits that introduce effects like reverb and tremolo.

⑦ **POWER TRANSFORMER:** Converts the 120 volts of power from the wall socket to a higher AC voltage and sends it to the rectifier tubes.

⑧ **TEN-INCH JENSEN C10R SPEAKER:** The transducer that converts the electric audio signal into airborne vibrations.

⑨ **FOOT SWITCH:** Because a guitarist generally has both hands occupied, this is used to trigger the reverb or tremolo effects.

⑩ **REVERB TANK:** A metal box containing four springs. As the audio signal enters, it is converted into mechanical action on the springs. Differences in the springs' length and stiffness cause sound to exit the tank at different times, creating reverb.

⑪ **ISOLATION BAG:** A sheath for the reverb tank that protects the springs from vibrations that don't come from the guitar.

* Photographer Todd McLellan is the author of the book *Things Come Apart*. He's also really good at destroying perfectly good appliances.



SKILLS

HACKS



THE JUNKYARD COLD SMOKER

How a bistro chef transformed an old dishwasher into the ultimate kitchen machine. **BY JOLYON HELTERMAN**

THE COMMERCIAL DISHWASHER OUTSIDE PAIN D'Avignon bakery on Cape Cod, Massachusetts, is belching out plumes of blue-tinged smoke, which is exactly what Matthew Tropeano, executive chef of the bakery's on-premises bistro, wants. The dishwasher is a cold smoker, a machine that imbues food with smoky flavor without fully cooking it. Tropeano had been hoping to add the technique to the kitchen's capabilities for some time. "We were already doing a lot of hot smoking . . . sides of bacon, whole chickens, tomatoes, you name it," Tropeano says. "But all the excess smoke was going nowhere. All we needed was to capture it."

Tropeano approached Richard Leboeuf, the bakery's maintenance supervisor, for help finding a vessel he could use to piggyback onto his hot smoker, a Landmann Smoky Mountain series. Leboeuf immediately thought of a broken Jackson Ware-washing Systems Avenger HT dishwasher he had sitting around in a warehouse. Leboeuf gutted the thing, removing the electrical wiring, the drain-line hose, the pressure-regulator valve, even the "built-in stainless steel booster heater with exclusive Sani-Sure technology." Then he added four-inch-diameter galvanized stove piping to funnel in the smoke from the hot smoker's vent.

The only remaining challenge was temperature control: The smoke that was exiting the Landmann was 300 degrees Fahrenheit, far too hot for cold smoking, which works best at 80 to 90 F. By fiddling with pipe length, Leboeuf landed on the optimal distance (five feet) for the smoke to travel to drop the requisite 200-plus degrees by the time it enters the dishwasher. Thus cooled, it can smoke delicate ingredients such as bluefish and house-made duck sausage. "We recently stuffed an entire brie cheese with black truffles and threw that in there," Tropeano says.

A year later the repurposed dishwasher remains a workhorse, despite near-constant use. It turns out a commercial-grade washer—designed to keep hot water from spewing out all over the kitchen floor—is an ideal machine for containing cool smoke. So solid is its construction, in fact, that the chef expects he'll be replacing the hot smoker long before its cooler sibling needs any attention.

Just in case, he's been eyeballing a backup: a hot water tank the bakery just threw out.

The bakery's hot smoker (at right) reaches temperatures of

300 degrees. Its cold smoker

sibling (at left and below) used to be a dishwasher.



THINGS YOU MIGHT ENCOUNTER AT THE BAR

REFRACTOMETER

He doesn't use it as often as a jigger, but Chad Solomon, co-owner of Dallas bar Midnight Rambler, often reaches for his Extech refractometer to make certain that the bar's cocktails are balanced.

The device, which resembles a small telescope, registers the amount of sugar in a liquid by measuring the refraction of light traveling through that liquid. Solomon uses his to make complex ingredients in-house, such as falernum, a spiced-rum base mixed with additional spices and lime oleo-saccharum, an essential oil from citrus and sugar. The refractometer ensures that Solomon can duplicate any ingredient within a 1 percent margin of error every time. It's like a measuring cup with a laser on it.

— ALIA AKKAM



TRY THIS AT HOME If you don't have a dishwasher lying around, you can buy a \$100 handheld cold smoker called The Smoking Gun. Place your food in a covered bowl, insert wood chips into the gun, and use the gun's rubber tube to infuse smoke into the bowl.

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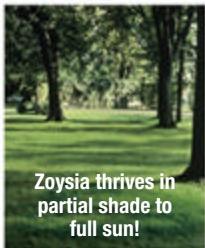


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SKILLS

AUTOMOTIVE



THE KIDS IN THE GARAGE

How to strip, repair, repaint, and rewire an old car—with help from an after-school auto club. Part three of a six-month series.

EVERY AUTOMOTIVE CLASS AT FREEDOM HIGH SCHOOL IN FREEDOM, WISCONSIN, starts the same: While some students pull out tools, others maneuver the program's project vehicles—up to twelve of them sometimes—around the garage. At the halfway point in our six-part series, the two cars the students are working on are ready for primer. This is the first time most of the students will have used a spray gun, so Jay Abitz, the school's automotive instructor, is encouraging them to focus on technique. "It's only going to get harder when they start spraying paint and clear coat," he says.

The proper technique: Hold the gun 4 to 6 inches away from the panel and spray a continuous line from one edge to the other. On the return stroke, move down to an unpainted area, but overlap the previous sweep by 50 to 70 percent. "If you go too slow you'll cause runs, and if you're too fast or too far away, not everything gets covered," says junior Nate Thompson. Thompson admits he has room to improve, but he has plenty of time: He plans to work on cars for the rest of his life.

→
**THE CASE
FOR BUYING A
QUALITY
SPRAY GUN**
by Jay Abitz,
Automotive Instructor,
Freedom High School

I'm not a tool snob. I'm totally not. But there is a huge difference between a good spray gun and a cheap one. At the adult night-school class I help teach in the Freedom garage, plenty of guys have their own nice guns. But some bring cheap guns and I'm like, don't even get that out of your truck, dude. You can use mine. Older guns don't atomize paint and primer the way the new high-velocity, low-pressure guns do. And when I've tried to take them apart for cleaning after just one use, I end up throwing them away instead. Cheaper guns just don't hold up.

→ **HOW TO**
**PRIME A DENT
REPAIR**

Tips from the Freedom High School Automotive Program.

CHOOSING A PRIMER

If you're restoring a panel or a whole car, you'll want to use a first layer of epoxy-based primer and a second layer of thick, urethane-based primer. Apply both with a gun designed for priming, such as a 3M Accuspray 07 series. If you are working on a smaller repair, such as repainting the dent you learned how to fill in our last installment, you can get by with a can of Sherwin-Williams P30, a primer-sealer. P30 adheres to bare metal and body filler, and you can spray it on or apply it with a standard paint roller.

APPLYING AND LEVELING

After prepping the area with a cleaning solvent, apply one coat of P30 over the body filler using a paint roller. When the primer has dried, use a high-grit sandpaper—600 to 800 (the label on the paint should recommend a specific grit)—to smooth the primer and create feather edging around the sides. Deep scratches will show through paint, so keep it soft for a smooth finish.

→ **NEXT MONTH**
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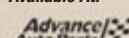
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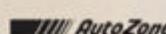
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ASK ROY

Popular Mechanics' senior home editor solves your most pressing problems. BY ROY BERENDSOHN

My condo shares a wall with the condo next door, and I can hear everything. Any advice on soundproofing?

Judy L., Santa Monica, California

Hate to tell you this, Judy, but soundproofing is best handled while a structure is being designed and built, not after the fact. Given that this is a common wall with another condominium, you'll have to find out what the local building department has to say about how to proceed. Unless you're an accomplished handy person, your best bet is to hire a contractor to carry out the modifications.

The most radical fix is to remove the drywall, insulate the wall cavity with fiberglass, and then install a noise-proof wall assembly with a dense, rubbery surface material known as high-mass vinyl and multiple layers of $\frac{1}{2}$ -inch drywall.

A less invasive solution, but one that is still effective, is to fasten a second layer of $\frac{1}{2}$ -inch drywall to your shared wall using a rubbery adhesive called Green Glue. You or a contractor should

apply this stuff in thick, intersecting lines on the back of the drywall before tilting it into place. When the glue cures, it forms a noise-damping layer. Finally, seal the edges between each sheet of drywall, the spaces where the sheets meet the floor and ceiling, and any gaps around electrical boxes with a noise-damping material like QuietPutty.

My house sits at the edge of a steep rock ledge. I want to build a deck and cantilever it out over the ledge. The view is going to be awesome, but I want to make sure it's safe. Advice?

Jack G., Rock Falls, Illinois

The view will be awesome. So will the risk. There's no question: Hire an architect or a structural engineer to design the deck. It's important that this person be licensed—that he or she has passed a test administered by the state. A person may have a degree in architecture or engineering, but that's not the same as being granted a license to practice. You will need the professional

Send your toughest house and yard questions to AskRoy@popularmechanics.com.

to certify a set of plans in order to get a building permit. Actually, the correct term is to "seal" the plans—professionals place a seal, a state-issued stamp that lists their license number, on a design that they approve. In most cases the building department will accept only plans prepared in this manner. Once your town approves the plans, it will charge you a fee and issue a permit.

Couldn't you skip the permit and overbuild the deck to be sure it's strong enough? Sure, but it's illegal. Second, that's not design—it's guessing. An engineer or architect will calculate the loads that are likely to act on the deck and design accordingly.

If all this sounds excessive, think of the alternative. You guess about the deck's design and you get it wrong. The deck sags or, worse, tears loose and takes you, your guests, the grill, and the dog on a sleigh ride you'll never forget.

This happens to me every year: Rock salt damages my lawn at the edge of the driveway and along the street. How can I fix this? These spots are the weakest part of my lawn.

Bob B., Bethel, Connecticut

As soon as the ground has thawed, flood the trouble areas with water. If possible, take advantage of the ground's slope to flush salt off the surface. If some areas are flat, all you can do is dilute the salt concentration. Water the grass until a puddle forms on the surface, then stop and let the water soak in. Repeat this procedure a little later. Two or three times should do it.

After this, thoroughly rake the area to remove dead growth and roughen the soil surface. Finally, apply grass seed and starter fertilizer. Keep the seeded area moist to ensure germination. Enjoy until next winter.

WHAT'S IN
ROY'S
GARAGE?

Our columnist
on his favorite
new tool.

Aside from a hammer, pliers are the most frequently used tools in your kit. They lead a hard life, so they have to be well made. That's why I was glad to try out Irwin Tools' Vise-Grip Max Leverage Diagonal Cutting Pliers. They're equipped with a compound-action hinge that, the company says, doubles your cutting force. The pliers can easily chop through stranded and solid copper wire, twelve-gauge cable, steel nails, and small machine screws—hardware that's usually reserved for small bolt cutters or big linesman pliers. This makes the Vise-Grip particularly useful for working in old houses, where you need to chop away junk before wiring in your new fixture or outlet. At \$30 to \$40 they're on the expensive side, but they're extremely sturdy. My bet is they'll last a while.



April 2012

POPULAR MECHANICS

PHOTOGRAPH BY PHILIP FRIEDMAN

Drive Smarter

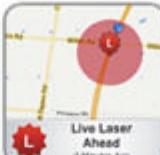
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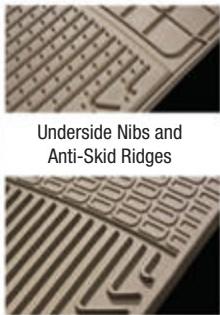
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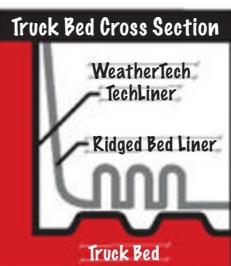


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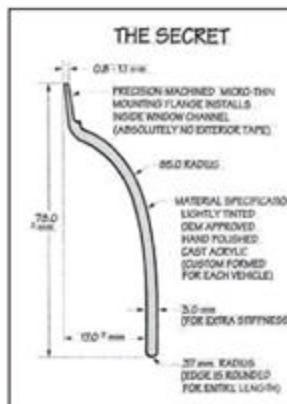
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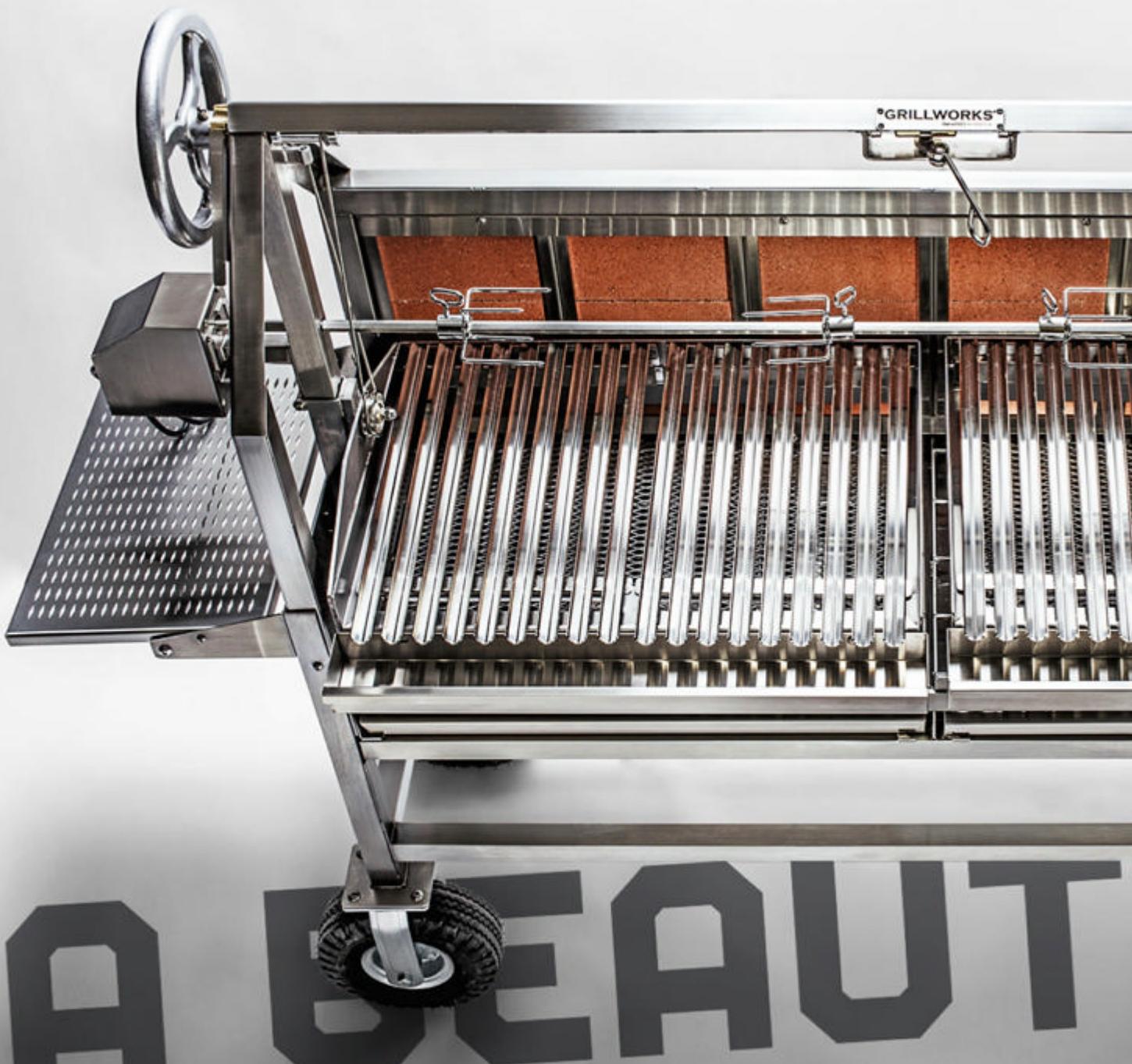
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A BEAUT
THING

The
Grillworks
Dual 54
CRE



IFUL

CHARLES EISENDRATH WAS A CORRESPONDENT FOR TIME magazine in the early 1970s, based in Buenos Aires and covering a nascent coup in Chile. While there he developed a taste for Argentinian open-fire grilling and the light smoky flavor you can get only from cooking over a burning log. When he returned to the United States in 1974 and started working at the University of Michigan as a professor of journalism, he spent his summer breaks in the backyard developing a grill that he thought could outdo what the Argentines had perfected ages ago. Through fourteen different prototypes (turns out aluminum doesn't hold up well under fire) Eisendrath created the gleaming stainless-steel structure that would become the foundation of his company. He outfitted it with details like V-shaped grates tilted downward at a 4-degree angle

to collect runoff juice and fat, preventing flare-ups and providing a reserve of liquid for basting. But it was Eisendrath's signature innovation, a flywheel system, that made open-fire grilling feasible. The wheel raises and lowers the grates over the fire, the temperature varying from 200 to 800 degrees Fahrenheit with a few cranks.

The operation clipped along as a family hobby that also happened to be a business for about twenty years, with his wife taking orders over the home phone. By the end of the nineties, though, the company, Grillworks, lay dormant. For Eisendrath, making the grills and trying to keep up with his university work became too much, and his day job won. Then in 2007 his son Ben got Grillworks going again. Ben, who'd hammered the serial numbers into the first grills as a kid, expanded the line beyond the original Grillery. Today they make large-format models like this behemoth along with custom installations for restaurateurs. The company may be out of his father's hands, but Ben has found a way to honor Charles and his invention. The "CRE" on the Dual 54 CRE, the biggest consumer grill they make, are his dad's initials.

The business is now split about half-and-half between home grills and collaborating with chefs and restaurants. No matter for whom, though, each grill is still made to order. The company relies on the local expertise of high-finish welders who learned their trade in Michigan's auto industry to assemble each grill. Dozens of man-hours from a single welder go into the smaller grills, hundreds for the big ones. Because the work is so specialized and the talent for it so rare, Ben has recruited apprentices from metalworking schools. That allegiance to local craftsmen, the longago reporting stint in South America, a love of American backyard cooking—these are

the details that make up Charles Eisendrath's life and that shaped Ben's. The grill is proof that the best ideas come from a life of such character. — MATT GOULET



IN THE SHOP

Often a single master welder works on a grill from start to finish. The craftsmanship comes at a cost. Residential grills start at \$3,000 and go up to \$13,975.

COMPANY: Grillworks

LOCATION: Ann Arbor, Michigan

OWNER: Ben Eisendrath



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CARS

By Ezra Dyer

UP AHEAD:

- 52 The future of car design.
- 58 Anatomy of an accident prevented.
- 60 Ezra takes the Sprinter 4x4 on a road trip.

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TO REALLY UNDERSTAND THE 2015 CHEVROLET CORVETTE Z06, you need a racetrack. With 650 horsepower and an available aero package that generates actual downforce, this is a car that best showcases its talents at extralegal speeds. Which it attains in a major hurry.

"It does zero to sixty in three seconds," says Z06 chief engineer Tadge Juechter. "And that's not using launch control or anything." To prove that assertion—and other bombastic Z06 stats, such as its 1.2-g cornering ability—General Motors brought a small fleet of Z06s to Spring Mountain Motor-sports Ranch in Nevada, where some of the car's development work was done. In the words of noted poet Bon Scott of AC/DC: "No stop signs, speed limit / Nobody's gonna slow me down." ▶

2015 CHEVROLET
CORVETTE Z06
PRICE: \$78,995

CARS

The quickest Z06s use GM's new eight-speed automatic transmission rather than the seven-speed manual. In a further affront to humanity, the Z06 posts its best lap times with its traction control engaged. GM calls its system Performance Traction Management, and a ride with chassis development engineer Alex MacDonald reveals that PTM requires a recalibration of my throttle-modulating instincts. MacDonald simply flattens the accelerator out of every corner, letting PTM sort out the power delivery. "We have a different philosophy with PTM than Porsche and Ferrari have with their systems," MacDonald says. "They're starting from the perspective that it's a safety net to help you go fast while enjoying your car. We're looking at it as a performance aid—even the best driver is going to go faster with this on than with it off."

"Get in an automatic car, step on the gas, and you've got zero to sixty in three seconds," says Tadge Juechter, the Z06's chief engineer.

That's because even the most sensitive right foot is outmatched by the LT4 engine's 650 horsepower and pound-feet of torque. While the last Z06 was high-revving and naturally aspirated, this one has a 1.7-liter supercharger nestled between its cylinder banks. GM considered turbos, too, but rejected them because the required plumbing would likely force the engine forward. A GM engineer tells me that, all else being equal, this engine would make 740 horsepower with turbos. But GM's logic is sound: This car needs weight over its rear tires more than it needs another 90 horsepower.

Which brings us to the question that always follows the release of a superlative new Corvette: Where do they go from here? In this case, a clue lies in the name itself, because the traditional top of the Corvette food chain is the ZR1. This car, you have probably noticed, is not a ZR1. Implicitly, then, an even wilder machine is on the way. And this time, just maybe, that machine has its engine behind the passenger compartment rather than in front of it.

After I pull into the pits and climb out of a car, Juechter asks what I think. "I think that to do any better than this, you need to go midengine," I reply. I'm tugging the tiger's tail—Juechter tends to get grumpy when you talk about midengine Vettes that don't exist rather than the ass-kicking front-engine ones that actually do. He grimaces and replies, "Yeah, that's what everyone keeps telling me."

I know, I know, the midengine Corvette's been a rumor and a pipe dream since the sixties. But if it does finally happen in the next few years, it won't be because of the new Ford GT, Acura NSX, or any other midengine competition. It'll be because of the Z06, a car so good that besting it might require an overhaul from the top down.



Original Badass The Chevrolet Corvette C5 Z06

The 2001 Corvette Z06 revived an obscure 1960s option code, applying the alphanumerical moniker to a new model that redefined affordable performance. The Z06 was lightweight—it had a titanium muffler and a fixed-roof hardtop body—and used a unique LS6 V-8 that generated 385 horsepower in 2001 and 405 in later model years. The result was monster performance, with zero to sixty in four seconds. Nearly a decade and a half later, the original Z06 is still quicker than a new Porsche 911 Carrera GTS. And you can pick up a nice one for \$20,000. It was a bargain when it was new, and it's an even better one now.

Say Hello to the Future of Car Design

Mercedes-Benz has a new concept car, and it's the carmaker's wildest one yet. Called the F 015 Luxury in Motion, the carbon-fiber sedan is designed with autonomous capabilities in mind. The open cabin is vast, ringed by screens, and has seats that rotate 360 degrees. Far from final (or totally realistic), the F 015 at least explores an increasingly important question: How do you design a car that can drive itself? —ANDREW DEL-COLLE





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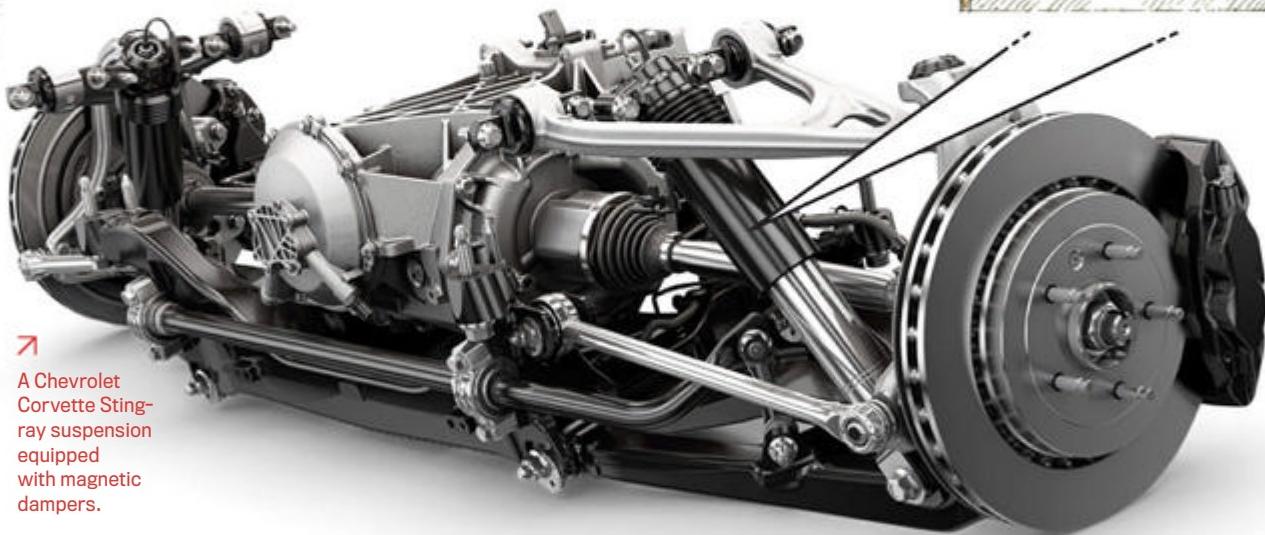
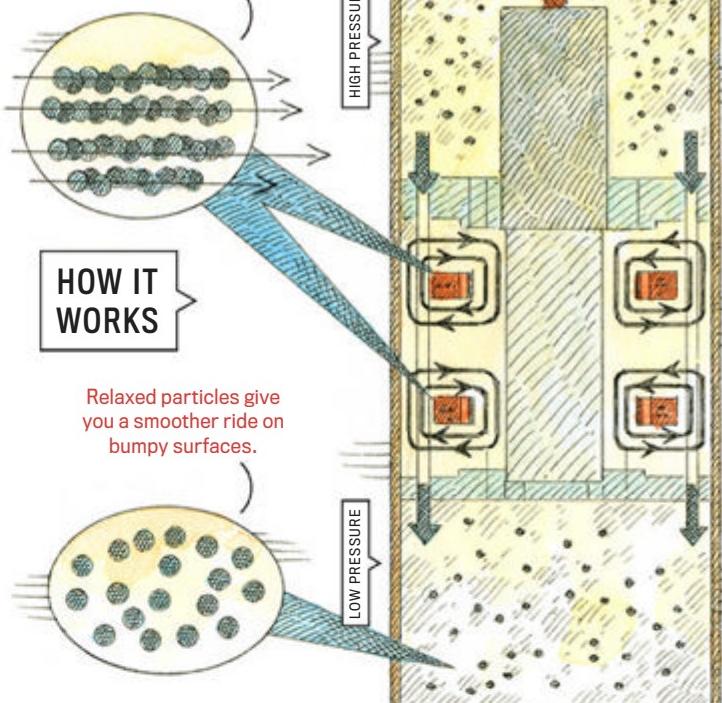
CARS

1

Magnetic Dampers

IF YOU ENJOY THE MAGNETIC DAMPERS on your Ferrari FF or Audi R8, you can thank General Motors for developing the technology. By varying electric current through a ferrous fluid, Magnetic Ride Control dampers can adjust their stiffness in response to driving conditions. And while the system is licensed to other companies, GM, as the originator, is still out front. Its third-generation Magnetic Ride Control (as seen in select performance cars such as the Chevrolet Corvette Stingray) improves on prior designs by adding a second wire. Now the fluid can be actively switched from firm to compliant, whereas before there was a lag as the particles naturally returned to their relaxed state. The implication? At sixty miles per hour the Stingray can adjust for each inch of road.

An electric current causes the particles to gather, firming up the suspension for increased performance.



A Chevrolet Corvette Sting-ray suspension equipped with magnetic dampers.

The State of the Suspension

It's good. Very good.

SUSPENSION SYSTEMS DON'T TEND TO get much publicity, but they're probably the most crucial factor in the day-to-day enjoyment of your car. Automakers are always tweaking and refining their designs in search of that elusive ideal: a perfect ride coupled with race-worthy handling. We haven't quite gotten there yet, but the latest systems are better than ever at reconciling the competing goals of comfort and performance. Here are three recent innovations to tide us over until Bose reinvents suspension entirely.

ILLUSTRATIONS BY JOHN BURGOYNE



Leaning into a corner reduces g-forces on the body.

2

Active Curve Tilting

MOTORCYCLISTS CAN TELL YOU THAT LEANING INTO A CORNER FEELS natural—too bad cars can't do that. Well, now one can: the 2015 Mercedes-Benz S65 AMG coupe. Using a lateral-acceleration sensor paired to a forward-looking camera, the S65 perceives corners and then uses its air suspension to tilt the body in toward the apex. The goal isn't higher performance but, rather, increased comfort as the passengers experience lower lateral loads at a given speed. Basically, if the road doesn't have a nicely banked corner, the car simulates one for its occupants. Proving, yet again, that it's nice to be rich.



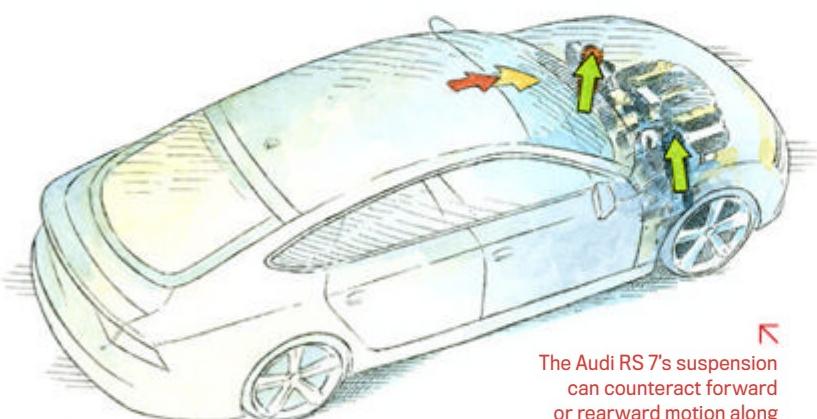
VS.



What Happened to the Bose Suspension?

BACK IN 2004 BOSE REVEALED THAT IT had been secretly working on an active suspension system since 1980. By using powerful electromagnetic struts, the Bose system could instantly extend or retract any one wheel, with all four corners working in concert to keep the car's body level. Bose demonstrated the system on a Lexus LS400 outside its headquarters in Framingham, Massachusetts, speeding the car over all manner of obstacles while the body remained completely serene—as a finale, the Lexus gracefully leaped over a piece of lumber in its path. It seemed like the dawn of a new era, and the company predicted that within a few years the system would be available in production cars. More than a decade later, where's our active suspension?

So far, only in big-rig truck seats, where the Bose Ride mounting system actively nulls shock and vibration before it reaches the driver. But cars are still the main prize, so we asked whether the system could be ready in five years if a car manufacturer committed today. A company spokesman replied, "Yes. Of course, we'd have to work with a car manufacturer on development and customization, but it's technically feasible. And when the right car customer is ready, we'll be ready." So there's your answer. Now who wants in on the suspension revolution?



The Audi RS 7's suspension can counteract forward or rearward motion along with body roll.

3

Hydraulic Roll Control

THE 2015 AUDI RS 7 IS THE LATEST CAR TO GAIN A HYDRAULIC CROSS-linked suspension, which Audi dubs Dynamic Ride Control. While conventional suspensions use steel antiroll bars to counteract body roll, hydraulic systems send fluid to the opposite side of the car. When you're not pulling major g's, the system stays out of the way, allowing unimpeded wheel travel and a smooth ride. It's like having huge antiroll bars and no antiroll bars at all, depending on the situation. The vehicles with the best compromise between performance and handling all use some version of this approach. Hydraulic cross-linking isn't perfect, but it's the closest thing right now to a full active suspension.

ASK EZRA

Your most pressing automotive questions answered.



Q I just turned 16 and will be purchasing my first car. My budget is about \$5,000 to \$7,500. I want something with good resale value and that is safe yet interesting. A classic American land yacht would be preferable. Suggestions? —EVAN BRANDAO, COLUMBUS, OHIO

A Wait, you're 16 and want a car? Shouldn't you be Snapchatting on your Oculus Rift or whatnot? Since you desire a nonvirtual transportation conveyance, an American barge is a fine way to go. For safety and reliability reasons, we'd err toward newer models. Now, you could pick up a 260-horsepower, LT1-powered 1994–96 Buick Roadmaster, but that's too obvious. Your budget would also get you a 1993–95 Ford SVT Lightning, Ford's original muscle pickup. But what you really need is a two-door, full-size Chevy Blazer or Ford Bronco from the late eighties or early nineties. They're dirt cheap, they've got V-8 power, and they're four-wheel drive—perfect for winter. The tops are removable, which is awesome in the summer. You can also get them with a manual transmission (and you should). They're not really cool yet, but they're about to be. The wizard has spoken: Your first car should be a truck.



2015 FORD EXPEDITION ECOBOOST 4WD

PRICE: \$47,965



My Almost Really Ugly Accident

Or, how I learned to love Audi's self-braking.

THERE'S NEVER ONLY ONE reason for an accident. Rewind the narrative far enough and somehow the sesame bagel you had for breakfast last Thursday ultimately causes you to sideswipe that Lexus on I-90. So it goes for me on the day when the 2015 Audi RS 7 I'm testing saves me from myself.

Here's how it happens: My contact lenses are bothering me all the time, so I decide to get evaluated for LASIK surgery. That means I have to wear glasses for two weeks. During this interval, a new house starts going up alongside a road I drive every day. One fine morning, doing about thirty miles per hour in the Audi, I take a gander at the construction—unaccustomed to glasses, I crank my whole head around to compensate for the lack of peripheral vision. The moment I do this, the guy in front of me realizes that the car in front of him is initiating a pain-

fully slow right turn into a narrow driveway. He slams on his brakes.

And that's your recipe for this particular collision: narrow driveway, slow right turn, new construction, impending LASIK exam, boom! Except, not. Because what happens is, the RS 7 goes into a full panic stop all on its own, without my foot anywhere near the pedal. Sure, I get on the brakes a moment later, but by that point the situation is handled. I'm just braking for self-esteem.

Audi calls its automatic braking system Pre Sense Plus with Braking Guard, and it uses radar sensors and a video camera to train unblinking eyes on the road ahead. I hadn't meant to test it, but I can vouch that it works great. Later that day I drove past the spot, and there were two faint stripes of rubber from the RS 7's soft snow tires, testament to the power of carbon-ceramic brakes. They're still there, ghosts of an accident that never happened.

ANOTHER CONVERT In recent years the big European SUVs have replaced their base V-8s with forced-induction V-6s. Ford follows suit with the 2015 Expedition EcoBoost, opting for the 3.5-liter twin-turbo V-6 from the F-150. With 365 horsepower and 420 pound-feet of torque, the turbo V-6 has diesel-like low-end torque along with robust top-end power. It tows 9,200 pounds, and fuel economy improves by two miles per gallon, to 16 city/22 highway for rear-wheel-drive models. Unlike on its Lincoln equivalent, the Navigator, the Expedition's intake is plumbed to hear the turbos huff and puff—a reminder that small engines and big trucks are no longer strangers.

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Welcome to
WEST VIRGINIA
Wild and Wonderful

The Go-Anywhere, Take-Everything Machine

The new 2015 Mercedes-Benz Sprinter 4x4 can haul a village while also conquering the nastiest roads. Time for a road trip.

THE DRIVE TO SNOWSHOE MOUNTAIN IS GOING GREAT until the 4-year-old throws up. I can't say I blame him—if I weren't the one driving, West Virginia's mountain roads might have me a little green around the gills too. Upon sight of the vomit, the 2-year-old starts making gagging noises. My 11-year-old niece, somewhere aft in the fourth row, barks, "Did Rhys just throw up?" I'm happy to hear from her, actually, because the Sprinter 4x4 I'm driving is so vast that you need to do a head count every time you climb aboard, and I wasn't a hundred percent sure we hadn't left her at that McDonald's back in North Carolina. Yes, the Mercedes-Benz Sprinter 4x4, the first version of Merc's high-roof van that can handle rugged trails as easily as smooth highways. That makes it your one and only choice for

twelve-passenger, four-wheel-drive transportation to snowbound mountains for a family ski trip. We have nine, in total—both my family and my sister-in-law's brood—with room to spare. I'd pegged the Sprinter as the ideal vehicle for this mission—four-wheel drive for the snow, huge enough for the mobile family reunion—but I hadn't anticipated the carsickness factor. West Virginia's roads would be a fantasy in a Porsche 911 Turbo, but the Sprinter is so tall that a tight set of S-turns makes you feel like you're on the top floor of a skyscraper during a 7.0 earthquake. The backup camera is nine feet off the ground (I measured), which makes it look like you're watching drone footage every time you put the van in reverse.

These roads offer no respite for a nauseated kid, so I stop to regroup at the next McDonald's. My

normal MO for a trip like this would be to hit the drive-through and keep everyone buckled in, but the high-roof Sprinter is incompatible with drive-throughs—the roof-mounted air-conditioning unit would get sheared straight off by any fast-food overhang. So we all trapse inside, where a gentleman near the window gestures at the Mercedes and asks, “That got satellite TV and everything in it?” I reply that no, it doesn’t. The Sprinter’s pretty no-frills, actually, positioned as a tool for tradesmen and would-be shuttle bus drivers such as yours truly. Upfitters like Winnebago and Airstream will be happy to turn your Sprinter into a rolling palace, but the standard van is a paragon of vinyl-floored industrial simplicity.

Still, it’s strangely fun to drive. En route to Snowshoe, I discover that the Sprinter is electronically governed to eighty-two miles per hour and practically governed to more like seventy-five when you’re going uphill—it’s 3.0-liter diesel V-6 is willing, but 188 horsepower isn’t exactly overkill for a machine the size of a Hong Kong condo. The airy, stand-up interior is convenient when my wife has to go back and deal with vomit, and, later on, a nosebleed from the 2-year-old. My biggest complaint: With a flat floor and no separate cargo area, any application of brakes or throttle is accompanied by the sound of my Founders All Day IPA fifteen-pack sliding beneath the seats, making its way front to rear and back again. (If I covered 400 miles on the way to Snowshoe, my beer probably did a 5k inside the van.)

About seven hours after leaving North Carolina, we finally arrive at Snowshoe. The spruce trees are

blanketed in white and the roads are awful—steep and slick. Up here, a local handyman runs an ad that reads STUCK IN A DITCH OR A SNOW BANK? CALL US FOR A PULL OUT! \$50 OR A CASE OF BEER WILL GET YOU BACK ON THE ROAD. The mountain gets 180 inches of snow a year and probably enough visiting fools to provide that guy with steady business.

Over the weekend the Sprinter serves as our taxi, our base camp, and our ski locker. And the four-wheel drive proves most necessary. At one point I put it in two-wheel drive to see what’ll happen, and we barely make it out of the parking lot. That’s why most shuttle buses around here are jacked-up four-wheel-drive Ford E-450s, mutant offshoots of the heavy-duty-truck line. But we won’t need them, because we’ve got our own all-terrain bus. Which, in fact, draws quizzical gazes from skiers and snowboarders waiting at the shuttle stops. They see the Sprinter and wonder if I’ll stop to pick them up. At one point, a shuttle driver heading in the

opposite direction waves to me—solidarity among the bus-driver brotherhood.

Eyeing the Sprinter 4x4’s price—a quite reasonable \$48,475—it’s tempting to think of this megavan as a smart alternative to a big luxury SUV. But you won’t confuse the Sprinter with Benz’s comfy GL550. The stiff, heavy-duty suspension sends bumps crashing through the structure, and you’ll be lucky to see seventeen miles per gallon on the highway. But if you’re heading to Snowshoe with both sides of your family, the Sprinter 4x4 is the only way to get in, get out, and never pay beer ransom to the tow-truck man.



“The Sprinter’s backup camera is nine feet off the ground, which makes it look like you’re watching drone footage every time you put the van in reverse.”

THE LAST OLD-SCHOOL VAN

While Ram, Benz, and Ford all offer modern high-roof vans, General Motors marches on with the Chevrolet Express, which looks not far removed from the set of *The A-Team*. With its low roofline, the Express feels claustrophobic compared with modern Euro-vans. But it can move just as many passengers—up to fifteen—and it offers way more power than anything else you can buy. I took a spin in a 2015 Express diesel, which uses the 6.6-liter Duramax V-8 from the heavy-duty trucks. The Duramax’s 260 horsepower and 525 pound-feet of torque make the Sprinter’s 3.0-liter V-6 feel quaint, and its 10,000-pound tow rating is also best in class. The Express isn’t exactly modern, but there’s still a place for the B.A. Baracus of vans.



2015 CHEVROLET EXPRESS DIESEL
PRICE: \$47,425

THE
POPULAR MECHANICS

FIELD GUIDE

TO

LIFE

PHOTOGRAPHS BY
DYLAN COULTER
ILLUSTRATIONS BY PETER OUMANSKI

An age-by-age manual to a lifetime
of competence.

Unless you count Nobel Prizes, no one is handing out merit badges for a life well lived. There's no handbook given to first graders that explains when you'll need to ride a bike, roast a chicken, jump-start a car, or nail a backflip off a rope swing—and how to do it. The real world is much more haphazard than that. In the crush of school and work and love and responsibility, it's easy to miss a few skills and not realize it until the time comes to use them. Though most of us have made it pretty far on our own, we could all benefit from an authoritative, well-researched guide to the most important abilities in life.

This is it.

MAKE A GREAT PAPER AIRPLANE



1



Fold an 8.5 x 11-inch sheet of paper in half lengthwise, then lay it flat on one side.

2



Fold the top two inches of the paper down toward you.

3



Fold that in half, then in half again.

4



Flip the paper over and fold both top corners toward the center.

5



Fold the plane in half lengthwise so that the front comes to a point.

6



Fold the wings up one-quarter to one-half inch at the ends.

AGE

1

— THROUGH —

AGE

11

HOW TO
TIE
YOUR
SHOES

Can't get the standard knot? Try this one. It's simpler, and bunnies make learning to tie your shoes fun.

1

Cross one shoelace over the other, push it underneath, pull it through, and pull tight.



2

Now make two bunny ears.



3

Tie the same knot with the bunny ears.



HOW TO PITCH A TENT

**PARKER
LIAUTAUD,**
polar adventurer

When four-time polar explorer Parker Liautaud embarked on his first trip to the North Pole, at 15, he'd never pitched a tent before. "I only learned to set up the tent when I saw it for the first time, which was when I got to Norway," he says. Liautaud, now 20, has learned a lot since then. Every tent is different, so the biggest thing, he says, is to practice. You should be completely familiar with all of your equipment before you ever use it in a real situation.

1 Choose your ground wisely. Of course you don't want to sleep on lava rock, but even little bumps can make your tent floor uncomfortable. If your tent is long, position it so that the narrowest part faces the wind. Otherwise the broad side will act like a sail, which could lead to a collapse.

2 When you take the tent out of its pack, don't lose or ignore any piece. Even a lost clip could mean a less structurally secure lodging. When you place the spikes, make sure the ground is solid. Placing them at a slight angle also helps keep the rope or tent holes from slipping off.

HOW TO

RIDE A BIKE

WHEN OUR SON TURNED 6, MY WIFE AND I BOUGHT HIM AN ELECTRA RATROD with twenty-inch wheels and orange and red flames on the black frame. For the next month Vaughn walked it around the backyard and gazed upon it as an art admirer might a Matisse. The only thing he didn't love about the bike was the idea of riding it. I tried on successive Saturdays to get him pedaling at the high school parking lot, but each time he managed only a few shaky revolutions before braking or toppling over. Characteristically, he became reluctant about the whole enterprise. He is an ebullient kid, but cautious. We try to nudge him along in life, toward the nicks and welts but also the joy that might follow.

One Saturday he mounted the bike and swiveled his head, red hair poking through the helmet. "Don't let go," he said.

"But you can do this," I said. "Once you start, just keep pedaling."

He sighed, but I thought I saw a hint of resolve somewhere in there. He began to churn his feet and I jogged behind him, gripping the saddle.

Riding a bicycle isn't just a physical activity or a competitive sport or a pastime. It's also a kind of freedom. It's a way to move through the world under your own power, maybe for the first time. Vaughn is 10 now, and he pedals to school and to see friends. None of us thinks much about this except occasionally, when I recall the day he learned to ride.

As he gained speed, I slowly lifted my hands off the seat. The bike pulled forward, smoothly this time. "That's it!" I yelled. "Go go go!" His feet blurred and he squeezed the handlebars and his face was intense but incandescent. I ran alongside him for twenty yards, cheering and shouting at him to keep going, until I realized I didn't have to tell him anymore, and he started to glide away. — DAVID HOWARD

HAMMER A NAIL

Jack was a weather-beaten framing carpenter on the first crew I worked on, almost forty years ago. I've forgotten his last name, but I haven't forgotten his instructions, which were these: Lose your fear of hitting your fingers. You will. It's going to hurt. Get over it.

If you're right-handed, place your left foot slightly in front of your right. Spread your feet shoulder-width apart. Bend your knees. When you need to swing with more force, grip the handle as close to the end as possible. For less force, choke up on the handle.

Don't use more force to drive a nail than you have to. You're trying to drive the nail, not kill it. And establish a rhythm. Rhythm is what makes the work happen. If you bend a nail, start another one nearby and keep going. Later, go back and pull the one you bent. It's less disheartening to fix a mistake when you can look at all the work you've done well.

— ROY BERENDSOHN

SHOOT A BB GUN

1 Learn about gun safety. Never point a gun at someone else.	2 Arrange a target about sixteen feet away. Soda cans, say.	3 Lie on the ground in a prone position, or prop the BB gun up on a ledge or wall.	4 Using your dominant eye, align the rear sight with the front sight.	5 Don't yank or pull the trigger. Squeeze it.
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HOW TO
PADDLE A
CANOE

If you don't want to turn away from the side you're paddling on, adjust the paddle parallel to the hull at the end of your stroke and press outward. This is called a J stroke.

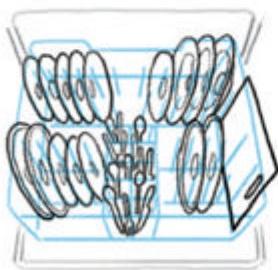
According to Alex Comb of Stewart River Boatworks in Knife River, Minnesota, who started building wood and canvas canoes in early adulthood, the first step in paddling a canoe is selecting a properly sized paddle. With your hands above your head in the surrender position, the distance between the pinkie edges of the palms should be just shy of the distance from the top of the paddle to the blade.



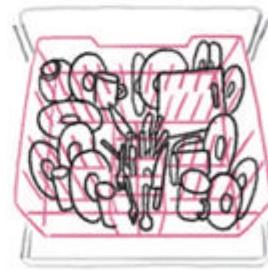
HOW TO LOAD A DISHWASHER

By soon-to-be-married PETER MARTIN and MERYL ROTHSTEIN, who do not agree.

PETER'S METHOD



MERYL'S METHOD



VS.

If you can use a parking lot, you can load a dishwasher. Those tines, like parking spaces, are not suggestions. They're guidance. Silverware is easy. Evenly distribute it among the baskets and vary the contents so that similar utensils don't stick together. Everything should be pointed down, but if the baskets get crowded, you can flip the spoons over. Glasses go up top, each in the row that leaves the smallest gap between its edges and the tines. Bowls also go up there. Light things, like Tupperware, need to go on top, too, with lids pinned between two bowls to anchor them. The lower rack is obviously reserved for flat things, like plates. Cutting boards or large bowls are fine, but only if there are no more plates. And everything should be facing the center, but that's just because it looks nice.

I've been told there's a right way to load the dishwasher. Bowls, glasses, and other curved things on top, plates on the bottom. Apparently there's a way to avoid blocking jets with an errant bowl, though I haven't found it yet. Loading the dishwasher when my caring and kind and really-anal-about-loading-the-dishwasher partner is home reminds me of twelfth-grade calculus: an opportunity to demonstrate how little I understand the formula. I'd say my approach is more CliffsNotes. It lacks sophistication, sure, but it gets the job done. No room left for that plate? Why not try it at an angle and see what happens? You won't know if you don't try. Sure, Peter's method is more efficient, but is it worth the effort? I've got better things to do than treat an appliance like a Rubik's Cube.

SWING FROM A
ROPE SWING

POPULAR MECHANICS
FIELD GUIDE TO LIFE

AGE

12

— THROUGH —

AGE

17

HOW TO
DO
A
DONUT

If your car is a powerful rear-wheel-drive, this is easy: Turn off your traction control, crank the wheel, and floor it. If you've got a gutless rear-wheel-drive car, you might need to brake torque to get the rear wheels spinning. Hold your left foot lightly on the brake while applying full throttle. Once the rear tires break loose, pop your foot off the brake and crank the wheel. All-wheel-drive cars can be trickier, but the same basic rules apply. Got a front-wheel-drive? Put it in reverse. Now it's a rear-wheel-drive.

— EZRA DYER

Pull the rope back so it makes a 45-degree angle with the branch. Wrap your legs around the knot and push

HOW TO

DRIVE A MANUAL TRANSMISSION

I DON'T EVEN HAVE A GOOD EXCUSE. I WAS BORN AND RAISED IN DEARBORN, Michigan, the cradle of the auto industry. By virtue of my residency I should've had a working knowledge of clutch basics by the time I started walking. And my grandpa, the man who gave me, a 15-year-old with a learner's permit, my first and only lesson in his little Mazda Miata, had been a driving school instructor back when every car had a standard transmission. His instruction didn't take, though, and I went nearly thirteen years not knowing how to drive stick. In that time my automotive handicap went from a slightly amusing non-issue—"Who has a manual car these days, anyway?"—to an actual detriment to my career—"Sorry, boss. I can't take this Mustang GT for a test drive because I don't know how."

Had I learned the first time, I wouldn't have had to ask Popular Mechanics' automotive editor, Ezra Dyer, to teach me again as an adult. On a blustery afternoon a few months ago, Ezra and I set out in a zippy Mini Cooper S for a lesson. It should have been a disaster. But, maybe because my license wasn't in jeopardy, I caught on easily. The motions became familiar, almost logical, in the two or three hours we spent looping around a remote park in the upper reaches of Manhattan. Foot off the brake, rev of the engine, foot off the clutch, and I was creeping comfortably along in first—then second!—gear. I got good enough to drive us through the rush hour wave back to the Popular Mechanics office, getting all the way up to sixth gear at one point. That's when I was sad that I hadn't learned to do this sooner. I'd missed out on thirteen good years of feeling that clutch catch as I push up on the shifter and zoom off. I intend to make up for them. — MATT GOULET



SURVIVE
ALONE IN THE
WOODS
JIM CANTORE,
meteorologist

When I was a kid, we moved from Connecticut to the middle of Vermont. Suddenly the people I went to school with had farms, they were working kids, and I'm just this little Catholic school boy thrown among the wolves. We never did any of that let's-go-out-and-sleep-in-the-woods-tonight stuff in my family. I didn't really know much in terms of life skills up there.

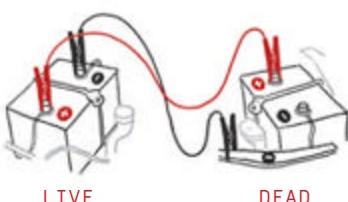
My high school football coach was the one who recommended Outward Bound to me. It was three weeks out in the woods in the middle of winter, trouncing through the snow and building fires out in Addison County, Vermont. You spend twenty-four hours out there alone, dig your own snow pit, and survive. You find yourself. It makes you realize that some things take discipline. You can't just show up.

LOCATE YOURSELF
ON A MAP
TRACY ROSS,
*former backcountry
ranger*

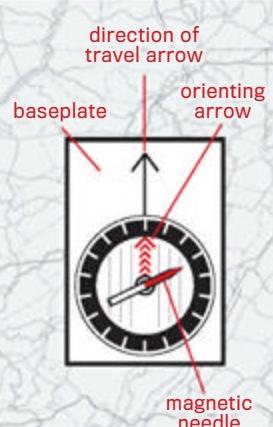
I didn't learn to read a map until I was in my thirties, and for this I blame Denali National Park in Alaska, where I used to work. Oh, we had maps, and we were supposed to use them. But Denali has distinct landmarks, including 20,320-foot Mt. McKinley, and most of the terrain is treeless tundra. You could almost always look to the mountains or the rivers and orient yourself.

When I moved to Colorado, I learned to locate myself on a map. To do this, point a compass's direction-of-travel arrow at a real-life landmark, then turn the circular dial until the red end of the magnetic needle is in the red orienting arrow. Place the compass on the map, aligning the dial's orienting lines with the map's north-south meridian lines. Keeping the needle in the orienting arrow, arrange the compass so the top right corner of the baseplate touches your landmark. Draw a line from the landmark down the edge of your compass. Repeat this process with two more real-life pieces of terrain. You're standing where the lines intersect.

HOW TO JUMP-START A CAR



Position the running car so that its battery is close to the battery of the dead car. Turn off the running car and get out jumper cables. Connect one end of the positive cable (the red one) to the positive terminal on the dead battery. Connect the other end to the positive terminal on the live battery. Connect the negative cable (black) to the negative battery terminal on the live car. Connect the other end of the negative cable to an unpainted metal surface on the dead car's engine. Start the live car and let it run for a few minutes. Now start the dead car, disconnect the cables in reverse order, and drive for at least fifteen minutes to let the alternator recharge the battery.



off. You will achieve maximum air when the rope reaches a 45-degree angle with the branch on the other side, over the water. Do a flip.



**HOW TO GET DOWN
A MOUNTAIN**
TODD RICHARDS,
*1998 U.S. Olympic
snowboarder*

The main benefit of learning to ski or snowboard when you're young is that you don't know what it's like to get hurt yet. As you get older, your brain becomes clouded with other stuff. At 45 years old, when I'm trying to make quick decisions, not only am I thinking, turn this way and lean that way, I'm also thinking about potential consequences: If you do this, that could happen and then you won't be able to work.

Get yourself a good lesson to start off. No offense to parents, but it's easier to take correction from someone who isn't related to you. Once you have the basics down, you can chase the sport in any direction you want. You can go to the X Games, the Dew Tour, the Olympics. You can be a crazy mountaineering snowboarder. It all comes down to being able to make very fast decisions using the two steel edges of your snowboard. If you learn how to do that right in the beginning, then you're all set.

Be sneaky. From your stance to your follow-through, try to keep everything the same as your fastball so you don't tip off the hitter.



**HOW TO
THROW A
CURVEBALL**

COREY KLUBER,
*PITCHER, CLEVELAND
INDIANS, 2014
AMERICAN
LEAGUE CY
YOUNG AWARD
WINNER*

I hold my curveball almost the exact same way that I hold my fastball—with my index and middle fingers just along the narrow part of the seam. It's just a matter of manipulating my hand into a slightly different position during the release.

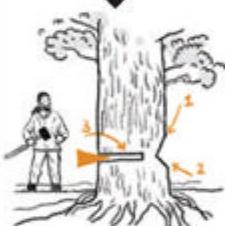
With my fastball, I'm trying to keep my two fingers behind the ball as long as I can to pull down on it and create as much backspin as possible. With the curve, instead of trying to stay behind, it's almost the opposite. At the very end of the release, you try to get your hand in front of the ball to create that topspin, which makes it break. You're rolling your hand forward and down off the side of the ball as you snap your wrist.

AGE

18

— THROUGH —

AGE

22**HOW TO**
FELL A TREE

A tree comes down in three cuts.

CUT ONE: At a 45-degree angle downward.

CUT TWO: At a 45-degree angle upward, to intersect with the first cut.

CUT THREE: Into the opposite side of the tree, parallel to the ground. It should be slightly above or equal to the point of the notch formed by cuts one and two.

Stop when there is a hinge left that's about 10 percent of the width of the tree. Pound a felling wedge into the cut and the tree should fall away from you.

Keep your guard up. If your hands have to come all the way up from your sides, you will telegraph your strike.

**HOW TO****THROW A PUNCH**

Stand with your nondominant foot forward, with 30 percent of your weight on your front foot and 70 percent on your back. Make sure your fist is tight with your thumb outside your fingers. Pivot on the ball of your rear foot and twist your waist in toward your target, carrying the energy up your back and down your arm. Drive your dominant arm forward and connect with the knuckles of your pointer finger, middle finger, and ring finger. For maximum effectiveness, imagine you are punching through your opponent. Walls are ill-advised opponents.

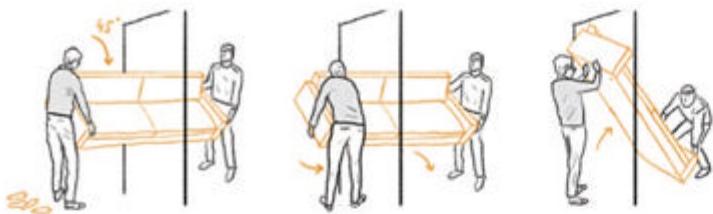
UNSNAP A BRA WITH ONE HAND

1

Facing the bra wearer, reach behind her so that your palm is facing her back.

HOW TO FIT A COUCH THROUGH A DOOR

URIAH DEAN, estimator, Moving Right Along moving and storage company, Ozone Park, New York



Take the feet off the couch, if possible. Tilt it forward at a 45-degree angle so the back faces up and the knee area faces down. Once you're most of the way through the door, turn the couch so that it's heading toward the open space. The person who's coming through the door last should shift his body so he doesn't get stuck between the couch and the doorway. If the area inside the door is narrow, the first person through should begin lowering the couch as the rear mover raises it to stand the couch up on its end once it's through.

HOW TO

PLAN THE PERFECT ROAD TRIP

HERE'S THE SECRET TO A GREAT ROAD TRIP: DON'T TRY TO PLAN everything. Lay out the structure, then let it happen to you. If you want a story you can tell for the rest of your life, you need conflict to drive it along.

Failures of every kind are what make the road trip I took out of Las Vegas in my twenties my personal best. A blizzard in the Northeast canceled our discount flight five days before Christmas, so my boyfriend and I, too broke to get on another airline, rented a convertible and drove to Dallas. It seemed like a better choice: Four days, 1,300 miles, home just in time for the holidays. The first night the sun set over a panorama of scrubland so wild and barren a herd of buffalo might have charged across it at any moment.

But then we took a detour to the Grand Canyon, because I had never been, and were pulled over by a cop on the way for driving a convertible in a whiteout like a couple of jackoffs. When we got to the edge, the whirling mass of fog and snow was so thick that you couldn't see your hand in front of your face. It was like opening your eyes in a bathtub full of frosting. We stood at the edge of the country's most prodigious maw and saw nothing.

I remember this trip in washed-out colors, like an old French film: the pastels of the gift shops on Route 66, the galaxy of Albuquerque reeling by in the night. At one of the motels in Texas, I made my boyfriend kick open the door to our room because it reminded me of the places Cormac McCarthy's hit-man psychopath stayed in *No Country for Old Men*. The trip was young adulthood in an itinerary: all the freedom of being over 18 with none of the responsibility. Living the way people say you should—for the story, rather than the outcome.

For those few days we planned to stay in that half-life forever. We didn't, of course. — JACQUELINE DETWILER

SAFELY LIGHT FIREWORKS

1

Choose a hard, flat location with a clear radius of at least thirty feet in every direction.

2

Fill a five-gallon bucket two-thirds full with water.

3

Arrange the fireworks with all fuses facing the same direction. Make sure none of the fireworks are pointed at people.

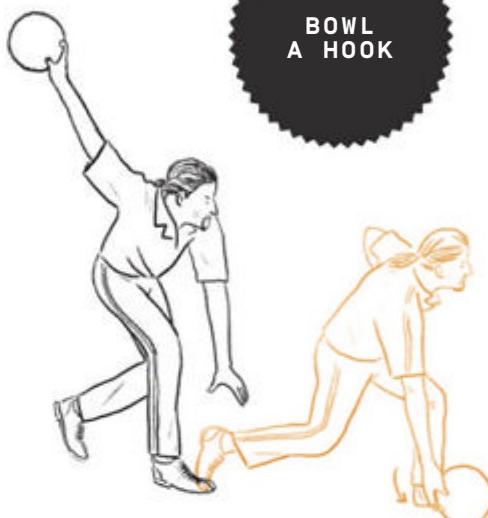
4

Using the longest fire stick you have, light one firework at a time, at the very end of the fuse.

5

Run! (Until you are outside the thirty-foot radius.)

BOWL A HOOK



Tossing the bowling ball straight down the lane may have worked for most of your life, but you're an adult now. It's time for a new challenge. Between the first and second row of pins is a six-degree pocket that almost guarantees a strike, but the only way to hit this window is with a proper hook. Here, Mike Fagan, most recent winner of the Professional Bowlers Association World Championship, explains how.

1 Start your swing, letting the weight of the ball carry your arm backward. Don't rush.

2 Use the momentary pause at the top of your backswing to make sure your hand is positioned underneath and to the inside of the ball as much as possible. This allows for maximum rotation.

3 As you release the ball, you want to rotate your wrist, not your elbow, to create spin. Your hand should follow all the way through the outside of the ball and be almost vertical on the follow-through.

4 Practice. As you get better, you can try rotating your wrist faster, which increases revolutions and, consequently, power.

2

Keeping your hand on the outside of the strap, pinch the middle (where the clasp is) between your thumb and index and middle fingers.

3

Push down and twist apart, like you're snapping your fingers.

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2015

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— THROUGH —

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HOW TO

MAKE A
BATCHED
COCKTAILDAVE ARNOLD,
*owner of
Booker and Dax
cocktail bar, NYC*

INGREDIENTS

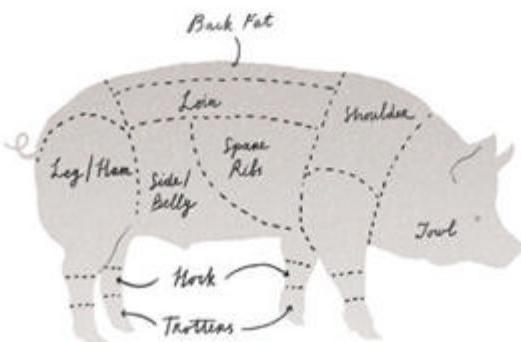
2 oz rum
 1½ oz water
 ½ oz simple syrup
 ½ oz lime juice
 1 oz grapefruit juice
 Pinch of salt

1. The ingredients above make one modified daiquiri. Multiply them to make as many as you think you'll need.
2. Mix all the ingredients and pour them into one or more quart-size Ziploc bags. One bag holds enough for four to eight drinks.
3. Place the bag(s) in the freezer overnight.
4. When you're ready to serve, remove the bag(s) and blend the drinks until smooth.

HOW TO
PLANE A
DOOR

Put a floor lamp or worklight on one side of the door. Stand on the other and nearly close the door. The light will reflect off the doorframe to illuminate the edge of the door itself. The part of the edge that is not illuminated is the part that's sticking. Make a pencil mark where the gleam of light tapers off, then make a small X on the dark side of the line. This is where you'll remove wood. Take the door off its hinges and stand it on its edge, supported by a pair of sawhorses. Use a hand or power plane to remove wood from your mark in the direction of the X, concentrating on the door's end. Remove just enough to get the door to close.

BUTCHER A PIG

CAMAS DAVIS, *founder, Portland
Meat Collective*

You can do most of the work with a five- to six-inch semiflexible boning knife. To work on bones, you'll need a saw with bigger teeth, or a cleaver. Remove the head, trotters, hocks, and tenderloin, then separate the pig into "primals." This means separating the back leg (the ham) and the front leg (the shoulder) from the middle section and splitting the middle section into loin (chops) and belly (bacon).

Next, turn the primals into subprimals. On the shoulder, for instance, this means separating the picnic roast from the Boston butt. From there, trim, sculpt, and debone the meat into the cuts you see at the meat counter. Remember: If you screw up, you can always make sausage.

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— THROUGH —

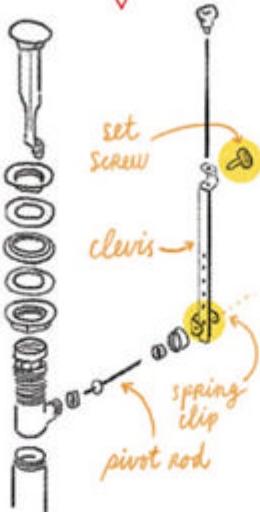
AGE

45HOW TO
WHISTLE
WITH
TWO
FINGERS

1. Make a circle with your thumb and index finger.
2. Curl your lips back tight over your teeth.
3. Fold the tip of your tongue over itself and place fingers on top.
4. Tightly seal your lips around your fingers.
5. Breathe deep and blow forcefully.
6. Adjust to find the right angle and depth. Unless you are some kind of whistling prodigy, you will not get it on the first try.

CHANGE
A
DIAPER

FIX A SINK DRAIN



It's not unusual to pull too hard on the lift rod of a bathroom sink—the thing that pulls down the drain plug—and find yourself holding it in your hand, plug stuck down for good. As an adult, you should be embarrassed if you have to call a plumber to fix this. In most sinks, the lift rod is connected to the drain plug by a mechanical complex that includes a clevis and a pivot rod (see diagram). In some cases the lift rod has been pulled off the set screw, which connects it to the clevis. To fix this, just put the rod back on the screw and tighten.

In other cases, the clevis has slipped off the pivot rod. If you can find the spring clip, slide it onto the pivot rod, wrap it around the clevis, and then slide the other end onto the pivot rod to secure.

MAKE A ROUX

A roux is not a mystery. According to Brian Landry, chef of Borgne Restaurant in New Orleans, it's just equal parts flour and fat, stirred like a risotto until it browns. You can add it to soups or stews to add thickness and flavor, and impress the heck out of your friends by making dishes like lobster bisque and Cajun duck gumbo. Learning to make a roux is easy. It's the half-hour of stirring that's hard.

HOW TO

GOLF FOREVER

ONE DAY IN 1991, WHEN I WAS 36, I WENT FROM HARDLY EVER thinking about golf to hardly ever thinking about anything else. A friend invited me to play nine holes and, even though I didn't hit one good shot, something changed in my brain. Since that moment, golf has been my No. 1 preoccupation. Most of my friends today are golf friends, most of the trips I take are golf trips, most of my remaining ambitions involve my swing.

When I began playing, I often wished I'd started in childhood, as my younger brother did. Within a few years, though, I realized that, in most ways, starting late had been an advantage. Unlike middle-aged guys who played in high school and college, I'm not haunted by how good I was when I was young. And, unlike my brother, I didn't have to put golf on hiatus during my prime playing years because of work and kids. My wife gave me a hard time at first ("I didn't marry a golfer") but that changed a few years later, when she, at 40, took up ice hockey. And because we came to our obsessions late, both of us—at 60 and almost 60—are still improving.

Among numerous other benefits, golf keeps its addicts interested in staying alive. I drive my car more slowly than I used to, because I worry that even a minor accident might be golf-threatening. When I walk, swim, or ride my bike, I do it because I believe that off-course exercise will help my game. And when I take up yoga—as I'm planning to do any day now—it will be because I know that increased flexibility will eventually enable me to extract a few more years, months, weeks, days, or hours for my swing. — DAVID OWEN

USE A
CIRCULAR
SAW

Mark a line across a piece of lumber. Set the saw's cutting depth to about half an inch deeper than the lumber is thick, then align the cut mark on the saw's shoe with the line you drew. Make sure the saw's blade is on the waste side of the line. Press the trigger. Once the blade reaches full speed, move the saw across. As you near the wood's far edge, push a little harder and faster so the saw clears the cut just as the waste piece drops free.

To make a plunge cut, as you might when producing a square hole, set the saw to cut a half inch deeper than the wood's thickness. Rest the front of the saw's shoe on the wood and pivot the blade guard back by moving the thumb latch fully forward. This sounds dangerous but it's not.

Now squeeze the trigger and pivot the saw slowly into the cut. Don't push. The saw will lower on its own as it makes contact.

1

Set up your station: Lay down a towel. Ready a clean diaper. Place ample wipes within easy reach.

2

Open the old diaper. Tuck the front half under the baby's bottom, clean front side of the baby.

3

Holding both ankles together in one hand, lift the legs and wipe. As many times as it takes.

4

Swap the dirty diaper for a clean one. Apply anti-diaper-rash agents and fasten.

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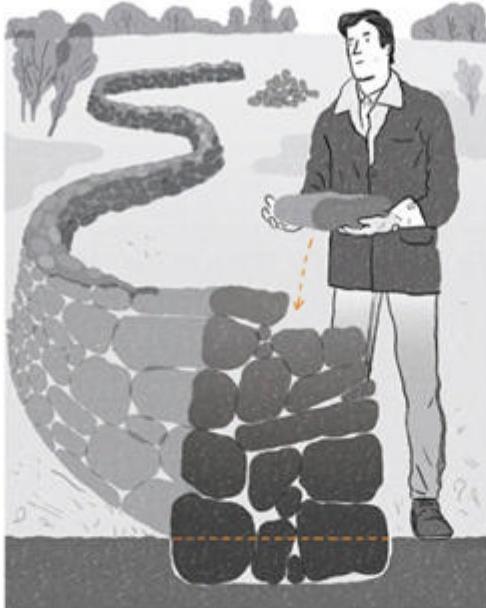
— THROUGH —

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PLAY POKER FOR
REAL MONEY
MIKIYO AOKI,
*high-stakes poker
player*

It's a pretty common poker saying: In order to live you have to be willing to die. If you're worried about losing your money, your hesitation will show in your body language. One trick I use is to convince myself that I'm holding a certain hand. If I present myself like I'm holding pocket aces—and I believe it even if I'm holding two terrible cards—I will project confidence. I will be harder to read. After a while, I learned to sense fear in an opponent. Maybe it's a tiny movement, a tightening in their face. You don't want to be that person. Create your own world, where you feel calm and in control. Playing for high stakes requires it.

**BUILD A STONE WALL**

A dry-laid wall adds gravitas to a property, a sense of acreage and potential horses. It looks like it should be an easy task to build one. It is not. First you'll need three piles of material: small, medium, and large.

Use stakes and mason's line to lay out an outline of the wall's direction and width. Dig a footing trench between the lines, about three to six inches deep. Make the bottom of the trench smooth and level. Lay the largest and heaviest stones at the base of the wall, stacking them so they slant toward the wall's center.

Use the two-over-one, one-over-two rule to ensure that you're not stacking stones of the same size directly over each other. Instead, lay them in an overlapping pattern, like bricks. Use progressively smaller rocks as you move up, and to fill in irregular holes.

**DRIVE
100 MPH
OR
FASTER**

We'll assume you're somewhere that this is legal, like the autobahn or the Bonneville Salt Flats. The most important thing about triple-digit speeds, the rule above all rules, is to keep your eyes up. Look as far ahead as you can. Don't focus on the area immediately in front of you: If anything were there, you'd hit it before you could react. Slow down your input to the steering and, especially, the brakes. Remember that nearly all street cars generate aerodynamic lift, which means that at 150 miles per hour the car has less grip than it does at fifty miles per hour. So don't ask the car to corner or brake as hard as it could under normal circumstances. And resist the urge to stare at the speedometer. A fleeting glance is all you need to prove to yourself that you did it.

**HOW TO
TEACH SOMEONE
SOMETHING**

THE WHITMAN COIN FOLDER WAS BLUE AND LEATHERY AND FOLDED IN THIRDS, with rows of circular pouches that sagged unless they were pressed full of Lincoln pennies. My grandfather gave it to me when I was at one of those restless ages—8 or 9—when I was annoying the whole household by banging around complaining of boredom. He was an engineer, a man of order. He had a kingdom in the garage that included a coin collection I was not supposed to touch. To still my fitfulness, he showed it to me. Inside an old chest were dozens of books like the empty one he had given me, each containing copper Indian heads or silvery buffalo in rows like a college class portrait. He had square florins from Aruba and yen with a hole in the middle. As I touched the coins, he told stories of old military campaigns. Restaurants that served fish eyes.

It was only once I had already fallen for the idea of collecting treasure that my grandfather got to the details that might have seemed tedious before. That a "D" or "S" under a penny's date was a mark from a mint in Denver or San Francisco. That a fine penny still had the designer's initials under Lincoln's right shoulder. He taught the guidelines one at a time, seeding my piles of change with extraordinary coins for me to discover. It was like he could see inside the mind of a 9-year-old, to the fantasies of international intrigue I careened around the house entertaining. He turned coin collecting into Nancy Drew and the secret of the steel pennies. He was almost 60. I was 9. But he knew. — JACQUELINE DETWILER

**HOW TO
IDENTIFY
PLANTS****WILD WATERCRESS**

WHEN: Early spring and fall
HOW TO CONSUME: Put it in a salad, like lettuce.

THREE YOU CAN EAT**CHICKWEED**

WHEN: Early spring
HOW TO CONSUME: Again, just like lettuce.

**BURDOCK**

WHEN: Fall the first year, spring the second
HOW TO CONSUME: Cook the root.

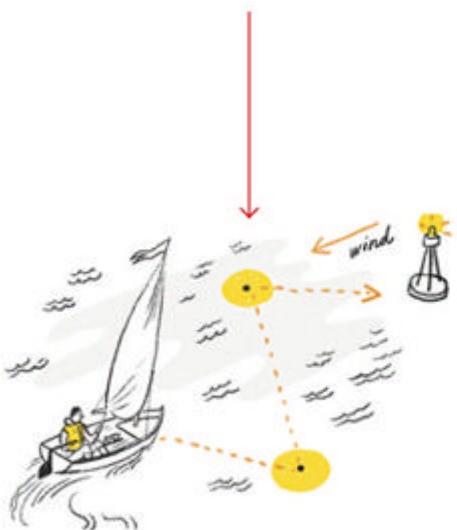
HOW TO

SAIL

STEVE WHITE,
owner, Brooklin Boat Yard,
Brooklin, Maine

Sailing is a lot like riding a bicycle: You don't really unlearn. You can do it on vacation every year. The best way to start is to go out with somebody who already knows how and just watch. Then the experienced sailor will have you take the helm or the tiller of the boat and aim for a buoy or something. After that is when you start with theory: You can't sail directly into the wind. You can only sail at so close an angle, otherwise your sails will flap and luff and the boat won't go where you want it to. This can be frustrating at first, but in the end it's what creates the joy of sailing. Once someone understands that, the best thing to do is to just leave him alone to make his own mistakes.

If you're sailing in the direction of the wind, you'll need to "tack," or change direction to take a zigzagged path.



THREE TO AVOID



POISON IVY

WHY TO AVOID: It causes dermatitis—itchy skin and blisters.



POISON HEMLOCK

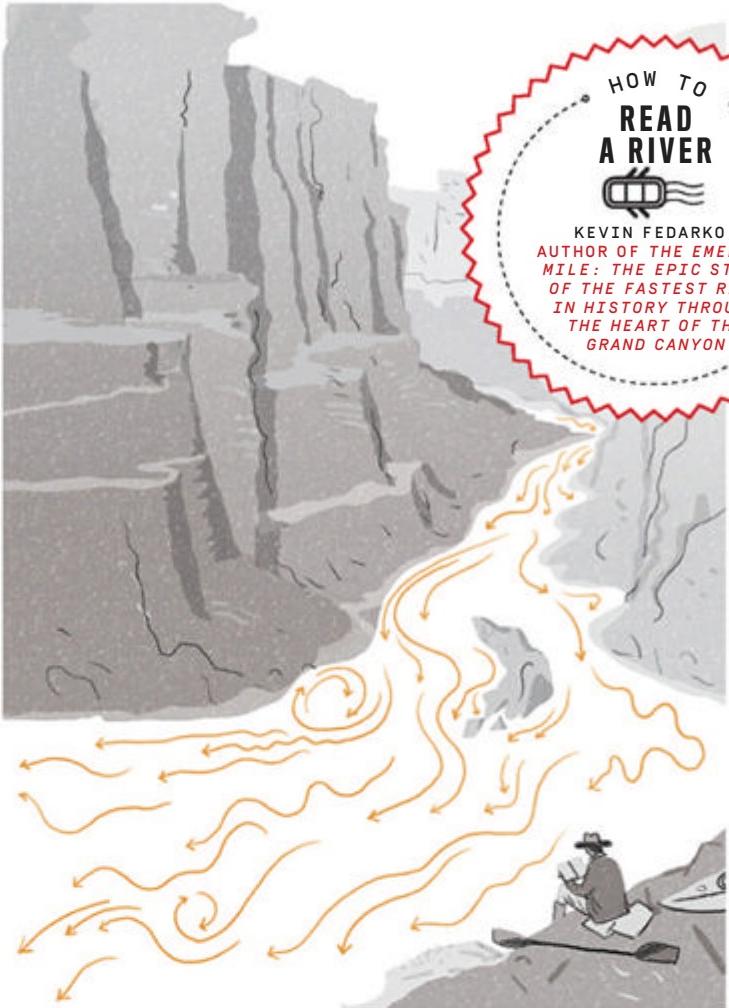
WHY TO AVOID: Consuming the root can kill you, like it did Socrates.



POISON SUMAC

WHY TO AVOID: Same reason as poison ivy—but even nastier.

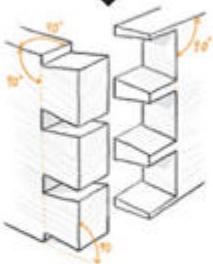
With thanks to STEVEN FOSTER, herbalist and coauthor of the Peterson Field Guide to Medicinal Plants and Herbs of Eastern and Central North America.



AGE

60+

HOW TO

MAKE
HAND-CUT
DOVETAILS

The first time I tried cutting dovetails by hand, as an apprentice cabinetmaker, I failed so miserably that my boss told me to cut the ends off the practice joint I'd made and throw them out. "You're not ready for dovetails," he said. He was right. Hand-cut dovetails—classic wood-working joints that use precise cuts rather than fasteners to join wood—are not the beginning but the culmination of a long string of fundamentals: You're not ready to make them until you can consistently mark a geometrically correct shape and then accurately cut it out using a dovetail saw and chisel.

Learning to hand-cut dovetails is a slow, meticulous process, but it's a rewarding one. A dovetail joint is a thing of beauty. A person who can make one well is a woodworker of consequence.

— ROY BERENDSOHN

HOW TO

FLY
FISH

Lift from your elbow,
with no movement in
the wrist or hand.

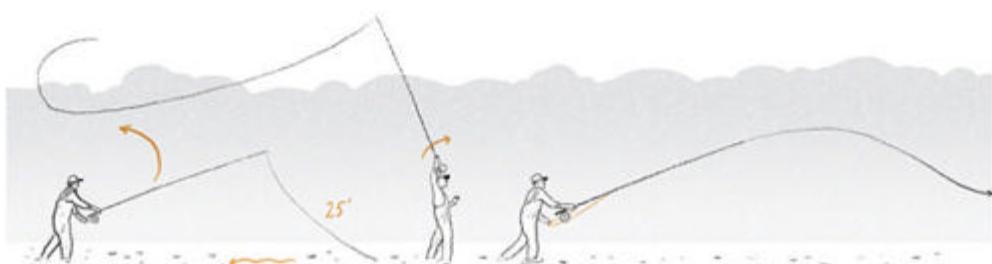


Start by facing up-stream and letting out 25 feet of line.

Young men start out wanting to catch a fish. Then they want to catch more fish. Bigger fish. A trophy fish. Old men just want to relax. They navigate a patch of water slowly—they have to. So they can study the tough casting situations. Old men discern rhythms of nature they previously would have blown right by.

So says Joe Humphreys, a retired fly-fishing instructor who caught his first trout at 6 and turned 86 a few months ago. He says it all starts with the basics: casting and line control. With the pole straight in front of you, lift the rod in a counterclockwise motion, accelerating until the rod is vertical. Now pause (Humphreys: "Say 'one hundred.'"). This unspools the line behind you. To send the fly to the water, flick your wrist forward like you're hammering a nail.

As for learning where to cast and what fly to use, that will take time. But that's the biggest advantage you have. — KEVIN DUPZYK



A SKILL FOR A LIFETIME FISHING

Not every hobby can be learned in a month, a year, or even a decade. Some are the blueprints to every skill a man ever learns.

BY

C. J. CHIVERS

SOME TASKS ARE SO RICH IN THEIR DEMANDS THAT THE HOPE of mastering them leads to the pursuit of others, and then to others, and so on for life.

When pursued with intensity, fishing works like that. Find someone who catches a variety of fish, season after season, year after year, in varied weather, habitats, and conditions, and you have almost certainly found someone who possesses a range of disparate but interlocking abilities. Being an expert caster, while a handsome competency, is nowhere near enough. Just as cats are not predators solely by claw, people who master fishing's main goal—consistently harvesting fish—draw from a fuller set of skills. They can handle and work on boats. They read weather, currents, and tides. They easily tie a multiplicity of knots—in ropes, wire, or line. They understand food webs. And they typically can put to use any number of tools—a cast net, a fillet knife and its sharpening stone, a miter saw when a dock or boat repair is required. They have forced their abilities to cohere.

This is why, in our house, fishing lies near the center of what my wife and I consider our children's living classroom.

This is not to underestimate the obvious: At heart, old-school fishing remains about catching and eating fish. The waters near our home provide us a large fraction of our annual protein, beginning with yellow perch caught through ice in winter, continuing with the spring squid run on a nearby oceanic shoal, and then plunging full-bore into successive finfish harvests deep into fall, as various saltwater species migrate near New England's shores.

But as our children learn to harvest the bounties that swim within reach, they are developing and honing many other skills, from simple carpentry to animal husbandry to cooking, brining, and pickling. We allow the possibilities to expand. Our gardens and fruit trees are fueled by fish frames—the bones and heads of fish with meat removed—buried in compost piles. The trellises and beds the kids helped build provide all manner of food (garlic, potatoes, onions, leeks, beans, squash, and tomatoes) that we serve with the fish. The turkeys and chickens the kids raise eat with delight any excess bait.

And always it is back to the sea, where each trip helps the children develop a sense of self-reliance and achievement. One weeknight last summer we were about fifteen miles out, tending the bottom in a rocky rip on a tide that had been dumping against a stiff wind. An ocean swell had been pounding across it all, creating a confused washtub sea. Once we had fish in the cooler, the crossing back to the mainland was black, and it bisected a shipping lane that required attention at the helm. (The boys, 12 and 14, pointed out the navigation lights on a tug towing a barge, determined its relative direction, and called out "all clear" on the course we had chosen.) Then, as we approached land, a blackout knocked out shoreline power, leaving little to navigate by as the hull covered the last stretch.

The boys hardly noticed. They spotted the seawall opening by scanning along a compass heading, then readied lines as we putttered up the channel past darkened docks before scooting cross-tide into the last tight passage. There they sprung from the gunwale to the dock to tie the boat off. I cut the engines, and listened as they continued the work.

AS OUR
CHILDREN LEARN
TO HARVEST
THE BOUNTIES
THAT SWIM
WITHIN REACH,
THEY ARE
DEVELOPING
MANY OTHER
SKILLS, FROM
CARPENTRY
TO ANIMAL
HUSBANDRY
TO COOKING,
BRINING, AND
PICKLING.

The next morning the two of them carried the heavy cooler from the pickup to the cleaning table, retrieved fish from ice, and broke out the knives. An hour or so later they had filleted the catch and buried the frames in compost beside the strawberry beds. Mick, who likes to cook, was talking recipes. Jack helped me think through the design and placement of a new block and tackle.

Everything about the rhythm we had fallen into showed that the old saw—give a man a fish and he will eat for a day, but teach him to fish and he will eat for a lifetime—only brushes the truth.

Teach your daughter to fish and she may become a biologist, a mechanic, a deckhand, a carpenter, and an artist, all on her spare time. You may find that you have a child who can free-dive with a spear, or build you a meticulously shingled storage shed with a classically pitched roof for your gear and lobster pots. And you will have fish, plenty to eat and plenty to share—an abundance of the food that propelled you all into motion in the first place, but required that you learn many other skills to succeed.



Forget the instructions! With LEGO bricks we can build anything we can imagine. Sean Kenney, a maker in Queens, New York, imagines a four-foot-tall duck.

PHOTOGRAPH BY LANDON NORDEMAN

POPULAR
MECHANICS



LEGO IS THE COOLEST COMPANY IN THE WORLD RIGHT NOW. BETWEEN THE HIT MOVIE, LICENSING TIE-INS, RETAIL STORES, AND ITS CONSTANT QUEST TO INNOVATE, THE BUSINESS KEEPS FINDING WAYS TO STAY RELEVANT AND PROFITABLE. BUT IT ALL COMES DOWN TO THE MAGIC THAT HAPPENS WHEN A KID SNAPS TWO BRICKS TOGETHER.

BY MICHAEL PATERNITI

TYPGRAPHY BY
ISTVÁN SZUGYICZKY





HEN HE DISAPPEARS, HE disappears behind the walnut door to his room—the door, it seems, must always be closed to seal him in his private capsule—and then there's the sound of banging and rummaging in the closet, the padding of feet, and the sudden jangly spill of Lego bricks. And that's it. We won't see him for two, three, four hours. He doesn't eat, he doesn't drink. We'll crack the door to make sure he's alive, and there in that slim line of light we can see the crown of his head bowed in concentration. His hands read the pieces off the floor like Braille, without his eyes having to see, and a flying machine suddenly materializes, or the minifigures amass for battle or celebration. Often he is making it up as he goes, talking to this world in low, sweet tones. Until the enemy arrives, or the monsters. Then his voice gets growly and a war ensues with the shattering of brick, one of the dangerous costs of believing in the permanence of your own self-made utopia. He is teaching himself a great deal about this world of ours, things we can't teach him ourselves. So—we retreat. He builds more. Dinner now, we call five times. And again. When he emerges, he's spent but smiling, half-here. He pushes a pea around his plate, eats nothing. When it's over, and he's cleared his dishes, he pads quickly back upstairs, the door bumps shut, another jangle of sound, the colored bricks, and he's gone again.

But where?



his studio assembling huge Lego models (eight-foot hummingbirds and life-size polar bears, or making little Lego lamps with the help of eleven hired assistants), what so few can put into words when it comes to the iconic building toy, is the strange thing that happens with the accrual of rectangular bricks (yellow rubber duckies! eight-foot hummingbirds!) and how evidence of these strange things can be found everywhere in plain sight when you begin to really pay attention.

"I think a lot of us makers are just trying to do something that's never been seen before," Kenney said. "Sometimes we're doing it just for each other, to inspire each other. It's like a conversation. How far can you push it? Can you surprise even yourself?"

I knew something about surprise, for in pursuing this story, I'd already bumped into a six-foot simulacrum of Mark Twain made out of Lego bricks in Hartford, Connecticut, and a life-size Queen Elizabeth II (in snowy palette) and Prince William (in regal red and royal blue)



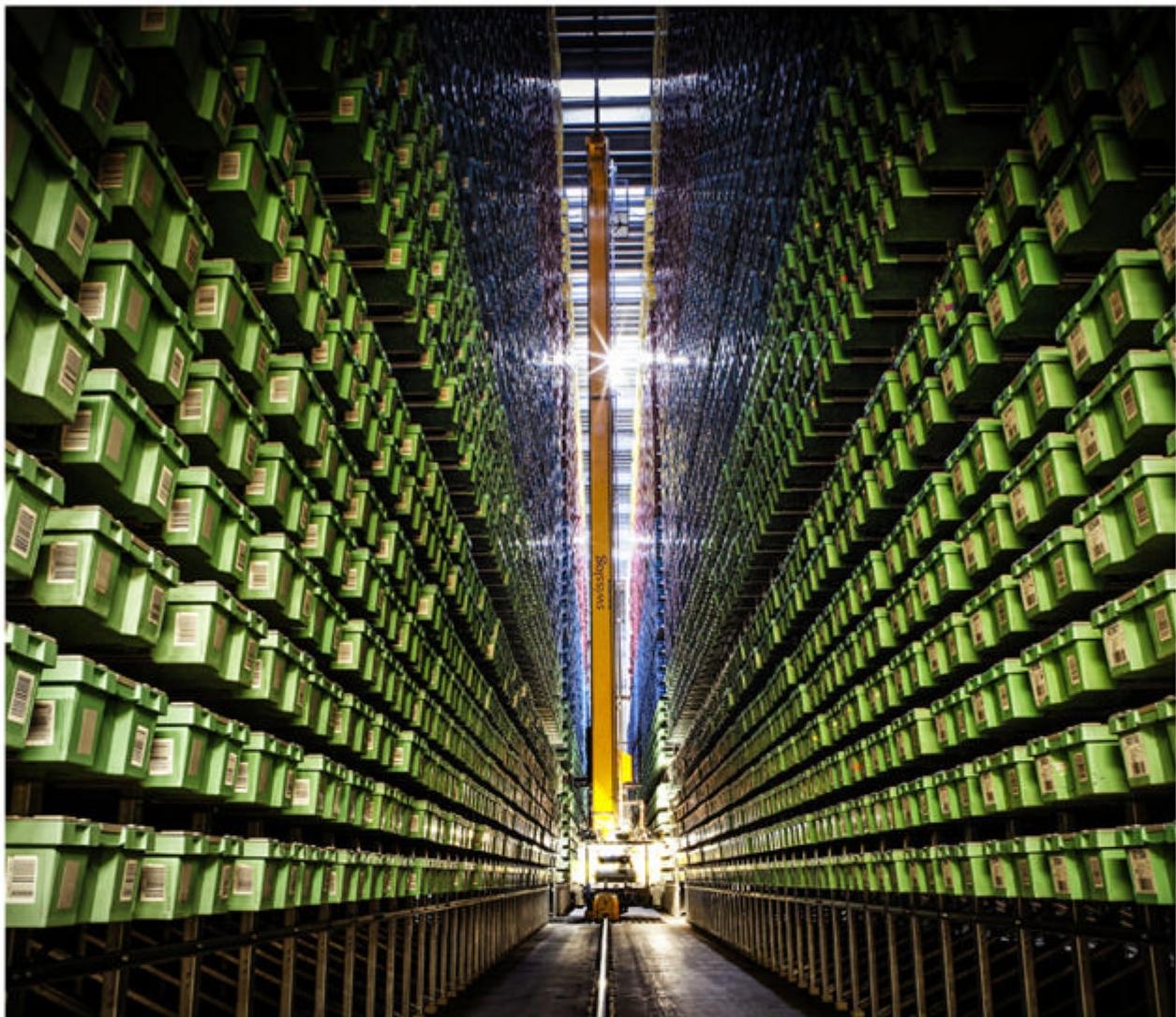
OLET THIS BE A STORY ABOUT TRYING to find my son, and a whole lot of other kids, young and old, wherever they go, behind the walnut door. And let it begin in a storage closet in the Long Island City neighborhood of Queens, New York, with a massive yellow duck. It's a mini monster, this duck, almost exactly like Ernie's rubber ducky from *Sesame Street*, but made out of nearly 25,000 Lego bricks—and the size of a Shetland pony. When I first saw it, when I came face to face with its peaceable expression of innocent no-thought and its adorable citrine bill, I couldn't help myself: I blurted out a laugh. More like an inadvertent snort, then laughter. *Who would ever think to make such a thing?* The answer was Sean Kenney, a youthful 38-year-old maker with reddish hair and blue eyes. In fact, up until the duck moment, I'd been having a somewhat serious conversation with Kenney about his lifelong obsession with Lego bricks and, more specifically, about how, in his work as a Lego artist and entrepreneur, his medium—these bricks—seemed so primitive and regressive, well . . . so *childlike*.

But underneath, of course, I was also wondering: *Why?* Why was this nearly middle-aged man still playing—or getting to play—with Lego bricks?

Kenney didn't disagree with the bricks being childlike. He wouldn't even call himself an artist, as he feels he's still playing after thirty-something years. When asked at what age he first began messing around with Lego bricks, there was no hesitation. His earliest memory of life itself was at 2 in a New Jersey suburb, surrounded by a loving family (his dad a rabid DIYer), on the floor with them: the rainbow colors, the feel, the satisfying interlocking click. He was like a bionic person half made of Lego bricks. Or his psyche was. On his website he calls himself a professional kid. What was *that*? And where might the rest of us sign up?

And yet right here before my eyes was visible proof that Kenney wasn't some sort of Pee-wee Herman: this gargantuan rubber ducky, retailing for a staggering \$39,000. "I compare it to getting your car fixed," Kenney said. "It's never the parts that cost that much, it's the labor."

What Kenney was so good at describing, besides this world he'd created for himself, the one in which he spends every hour of the workday behind the door of



built from the same in London. I had met a young guy—another maker—who kept building bigger and bigger robotic models, just for fun, until he was hired by various companies at the age of 24 to model factories out of Lego bricks before the companies went ahead and built them for real. And I'd bedded down in a Lego-themed hotel at Legoland in Billund, Denmark, where in the lobby there was a massive, Smaug-like Lego dragon, a Darth Vader, and Stormtroopers, and where at breakfast there was such a happy crush of rampaging runtlings, all ricocheting around with primitive Lego creations in hand, you could scarcely reach the pastry table.

Along the way, too, my son—the one who'd spent his boyhood behind that walnut door building with Legos but who was now 14 and seemingly outgrowing the toy—came with me to Billund, where the bricks were first manufactured in 1949, and for the better part of a week he forwent his increasingly exciting social life and constructed stuff out of Lego bricks again. After returning home, while sifting through some old boxes, I came upon a lost photo of my son

with a Lego skyscraper he'd made when he was 9, a simple tower nearly seven feet tall, him beaming just as he had when he'd shown me a spacecraft he'd built with wings and a control room a few days earlier, in our pirate-themed room in Legoland.

The same expression, the same boy.



ERHAPS IT TAKES A PLACE AS ORDERLY as Denmark and a rather sleepy town like Billund, in the interior of the Jutland peninsula, to have given birth to the Lego legend. You can actually hear your own thoughts here among the salmon streams and beech trees. And without much else to do, the imagination has room to take its powerful precedence too.

In the case of Ole Kirk Christiansen, master carpenter and joiner, there seems to have been a lot to think about, and imagine as well. His story's been told before, and certainly burnished, but it bears repeating: According to company lore, having bought a modest

The Lego factory in Billund produces about 20 billion individual pieces a year—about 38,000 per minute.

When they first created minifigures, Lego officials decided the faces should have only one color—yellow—and wear a neutral expression. Now the characters come in countless guises and moods.



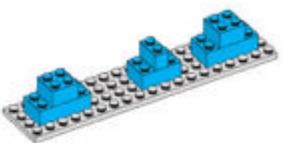
furniture factory in 1916, Ole Kirk built a dairy and church for the town. And with wooden scraps from the factory, he began to make toys, formalizing the operation in 1934 with the name Lego, adapted from the Danish *leg godt*, which means play well. Making toys was less an act of whimsy than of priority and business proposition—and his vision, it would seem, was communal from the start. With the death of his wife, Ole Kirk was left with four young sons to educate and entertain. At first the toys were simple: a painted duck with wheels, a truck. And yet his restless mind led him to a manufacturing fair in England after World War II, where he was introduced to a device known as the Windsor SH Plastic Moulding Machine. He became the first to buy and bring one back to Denmark.

It had all the makings of a folly or a fairy tale: The widowed toymaker living in a house in the middle of town with his four boys, spending his money and time on a machine that might spit out these plastic bricks he had in mind. But by then the boys were grown and the toy company had close to fifty employees. Already Lego was playing with the idea of exporting its wooden toys, as well as diversifying—that is, making toys in plastic. Ole Kirk called his new product Automatic Binding Bricks, which were cribbed in part from the British Kiddicraft Self-Locking Building Bricks. Like the Kiddicraft bricks, Ole Kirk's were at first hollow plastic rectangles. He sold them in four colors, only in Denmark, without the interior tubes that would soon revolutionize everything.

Today the company is still family owned, primarily

by Ole Kirk's grandson Kjeld Kirk Kristiansen, who, according to *Forbes*, has a personal fortune of nearly \$10 billion. (Even in the recession of 2008, as the toy industry died on the vine, Lego profits were up 31.5 percent. Last year, as further evidence of the brand's enduring popularity, *The Lego Movie* grossed nearly half a billion dollars worldwide.) In the center of town, the toymaker's original house is now a quaint museum called the Idea House, and one exhibit shows Ole Kirk's mind working on the initial problem of building a better brick. A patent application itemizes at least twelve designs with which the company was experimenting, or perhaps claiming as its own to block future competition. What emerged from this cogitation was the simple, if multifarious, Lego brick as we know it, with its familiar, almost primitive interior tubes and studded surface, which, when attached to another brick, creates instant stability and what the Lego people call clutch power. In other words, small hands can attach and unattach the bricks with this "stud-and-tube coupling system," while the bricks are strong enough to build with, sometimes elaborately.

From the start the toy exploded in the marketplace. By 1958, the year that the stud-and-tube coupling system was patented (and the year Ole Kirk died, passing final control of the company to his son Godtfred, who was already developing a unified "system of play" for the company by creating a standard brick that could be used in every set made thereafter), Lego had 140 employees. Two years later the company abandoned wooden toys altogether, when it had 450 employees in



Billund alone and eight foreign satellites. By the early sixties one employee could work two plastic molding machines at once, and production continued to expand with play kits and minifigures (born in 1978), as well as an array of new pieces, products, and eventual movie tie-ins. Today Lego employs nearly 14,000 people, is sold in 130 countries, and has roughly thirty product lines (from *Lord of the Rings* kits to Lego Mindstorms, from which one can build motorized robots). Having opened new factories in China, the Czech Republic, and Mexico, the company now makes more than 55 billion Lego elements a year out of 4,200 tons of ABS, a thermoplastic polymer. It's said there are about a hundred bricks per person on earth.

"People will tell you they have their own path to playing with Legos," said Michael McNally, a company spokesman. "Everybody has different sets. I began with Legoland, the town, and I love Lego Architecture. Someone else loves *Star Wars*. Or Mindstorms. People like to talk about the infinite with this system, but it's also very limited because [the brick] is a rigid geometric form. So the idea that you can look at something finite and see infinite possibilities in it, and believe you can make something round out of it even though it's square, is very hard to explain. I think in other cultures we might have rounded the edges because someone wanted them round, but I think there's something to this idea of discipline and restraint that almost liberates these forms. Lego bricks can be anything you imagine them to be. That's really their appeal."

This not-knowing-the-mystery, as well as the creative act of bending the material, or reshaping its shape to match the one in mind, may partially lie at the heart of Lego's greater addictive appeal too. And perhaps it's a Danish diffidence, an under-assumption about what the company is really meant to do for its customers (after some dangerous years of over-assuming, years that nearly led to bankruptcy during the early 2000s), that leaves an open space for us, the makers.

During my visit to world headquarters, in Billund, I repeatedly met with people—make that employees who've made Lego bricks their life work—who also struggle to understand the exact algorithm for the brick's ubiquity. Headquarters here are modest-looking, low-slung buildings made mostly of yellowish brick, and because the town is so sleepy, many of the employees commute up to an hour each way from bigger towns. The company culture is decidedly unpretentious—and employees really do seem to subscribe to the 11 Paradoxes of Management listed on a placard hung in every Lego manager's office, these three, among others, calling for individuals "to be a visionary—and to keep both feet firmly on the ground. To be self-confident—and humble. To take the lead—and to recede into the background."

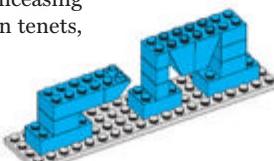
Lego clearly isn't an oblivious collective of elves making a magic toy. "This is our heart and soul," said Roar Rude Trangbæk, Lego press officer, while giving me a tour of the factory, a fully modern, automated, fifteen-acre warehouse replete with 750 of the latest versions of that old Windsor SH Plastic Moulding Machine. Working off computers, the machines purred in a low hum, fed by pipes teeming with ABS pellets. When heated and liquefied, the material fills a mold, cools to its particular shape, and then is ejected in that jangle of color, cheap jewels filling bins until they're swept away by robots, destined for whatever particular set will excite its clamoring fans or offer complete satiation on Christmas morning. But even in its unceasing production, the Lego brick is animated by ten tenets,

It was the MIT Media Lab that devised the programmable brick, which contained an embedded computer capable of controlling a Lego model.

first codified by Godtfred in 1963. It seems a lot to put on a piece of plastic, but in boiled-down corporate bites these are:

1. Unlimited play potential
2. For girls and for boys
3. Fun for every age
4. Year-round play
5. Healthy, quiet play
6. Long hours of play
7. Development, imagination, creativity
8. The more Lego, the greater the value
9. Extra sets available
10. Quality in every detail

In the conversations that ensued at world headquarters, I noticed some recurring themes: Most employees claimed an early love for playing with Lego bricks (that they, too, were the boy or girl behind the walnut door); evoked their bosses, the Kristiansen family, with glowing, if slightly cultish, praise; emphasized the low-key, inclusive company philosophy that continues to highlight the educational rewards of playing with Lego bricks; and spoke to the need for corporate secrecy regarding future plans and ongoing research ("We don't necessarily feel we're competing with other toys or games," said one employee, but he clamped shut when asked with whom or what Lego was competing, then); and ended each conversation somewhere between the twenty-third and thirtieth minute with a somewhat brusque insistence on how busy they were. At a company in forward motion, and with pressure to



produce during the relatively sane number of hours in the Danish workday, there seemed little time for floaty reflection or declarative me-statements here. The folks at world headquarters are happy to leave that up to others. Meanwhile everything's on an egg timer, and you can almost hear the sucking sound of an incredibly lucrative enterprise needing their attention to maximize profit. If there was a disappointment, at least for me, it was that, except for the designers, none of the adults here seem to have any real time to play.

At one point, back at the Idea House, I was led into what the Lego people call the Archive, but it might best pass as the Stacks of Past Memory. These are huge, hand-cranked bookshelves, more or less divvied up by decade, containing almost every Lego set ever made. It's an astonishing thing, really, and some of the most obscure kits were bought on eBay. Found down here are the first Lego Mursten (or Building Bricks), and the Big Town set from 1961, and the automated Lego train and Lego Space from the 1970s. The stacks from the eighties and nineties bring an assortment of Duplo products (the bigger Lego brick) and Lego Mindstorms, while the 2000s lean more heavily on the action figures and movie tie-ins, from the Vikings sets to the Harry Potter set scenes. And let there be no doubt, somewhere in this plastic cornucopia is the game or set that once belonged to you too.

It's said that people get lost in the Archive for hours. In fact, afterward, several Lego employees asked me if I'd cried on my visit there. (I hadn't, but when my son came upon the Millennium Falcon in the 2000s stack, the first big Lego kit he ever completed on his own, he gave a little yelp of joy.) They asked because either they themselves had—or they'd heard the many poignant stories of others who, when confronted with the Lego set of their youth, had had a sort of *Wild Strawberries* moment, powerfully recollecting the hours spent lost in the pure pleasure of this particular kit or remembering the person by whose hand they'd been given the gift . . . and then they'd found themselves absolutely

overcome by this wave of strange joy/sadness, or grief/elation, or whatever it was that only a simple, infinite plastic brick could mysteriously evoke in a person reaching backwards in time for something there/not there, namely his childhood.



FEW WEEKS LATER, BACK ON THIS side of the ocean, I took a New England road trip. At each stop—at MIT's Media Lab to meet with renowned educator Mitchel Resnick, at the bustling Lego Model Shop in Enfield, Connecticut, and

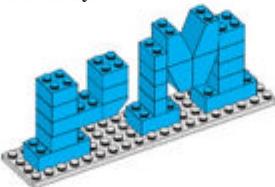
in New York City, hive of Lego makers—I was met with a blast of effusion. Though I was talking to grownups, it felt over and over again as if I were entering through the door of some geeked-out kid's room, one towering with Lego inventions and scattered bricks everywhere and the breathless monomania of perpetual youth. There was something in the primitivism of it all, the clicking bricks and blocky figures, the sophistication and simplicity, the splendor and rusticity that links the present and the past, that created some deeper disturbance of comfort.

Situated near the Charles River in Cambridge, Massachusetts, MIT's Media Lab is a glass-and-metal building where Resnick, perched on the fourth floor, resides in a world of inquiry meant to lead today's kids to new, sticky learning experiences. Among other things, he and his team have developed a computer program called Scratch, which enables children to make their own video games, animation, and interactive art. "We're always about kids creating, building, designing, and inventing," Resnick said. Dating back to 1985—when Lego first struck up a partnership with MIT—the Media Lab has made the Lego brick one of its primary focuses. In fact it was Resnick and his research group who came up with the idea of the programmable brick, which contained an embedded computer capable of controlling a Lego model. They created bricks with chips. The result of their work, in turn, led to the first iteration of the Lego Mindstorms line.

(The agreement between the corporation and the university appears clear-cut: Lego donates an unspecified amount of money each year—beyond the \$5 million it earmarked in 1999 for Resnick's connected Lego Learning Lab—while having access to the research that comes as a result of its investment. That is, beyond Lego's donation, MIT doesn't benefit from any applications it develops for, or with, Lego bricks, though Lego supports the lab's research into, among other things, smart materials, embedded computing, and attempts to understand how and what children learn through play and develop new ways to make their playtime more expansive. The company also provided seed money for the Playful Invention Company, founded by Resnick's colleagues, in order to test more ideas in the marketplace.)

As part of the partnership, Resnick finds himself in Billund four or five times a year—and guides his own research by the Lego mantra of "Joy of build-

4
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"Instead of panicking that the tactile toy will never survive, we realize that kids want the tactile and digital to work together. It's not discrete, it's complementary."

MICHAEL MCNALLY

LEGO SPOKESMAN

LEGO BROUGHT TO LIFE

A GALLERY OF PROJECTS BY THE KIDS OF PM READERS



Lila and Jack J.
PARK CITY, UTAH
A megarobot named
Avalugg



Jake B.
RIVER VALE, N.J.
A ship with a rescue
crane



Aidan O.
BROOKLYN, N.Y.
A wing jet and a Batman
glider



Fletcher G.
LOS ANGELES
Benny's ship from *The Lego Movie*



Jake S.
SHORT HILLS, N.J.
The Power Plant 6000



Jackson B.
CLAWSON, MICH.
A spaceship



Bradley R.
RALEIGH, N.C.
A bust of Homer Simpson



Wyeth and Auden L.
NORTH SALEM, N.Y.
A tropical island getaway,
an old-fashioned plane

tions. That's not great either. We want kids to imagine new worlds but have some structure in order to build them."

Resnick continued, "One of the things I like about *The Lego Movie* is the core message: Don't just follow the instructions. Be creative. The best learning experiences will come when the kids are the designers, when kids aren't just watching and listening but creating. Of course we always learn from watching too. If a movie is inspiring kids to become builders, creators, designers, I think there's a great role for it. One thing I worry about with new technology—computers and gaming—is that people talk about interactivity, but if interactivity is just moving a joystick and pushing buttons to control a character on the screen, that's not joy of building or pride of creation."

If we are headed toward a future in which increasingly complex digital-physical integration will become the norm in play, Lego officials seem unfazed. "The way we look at it is simple," said Lego spokesman Michael McNally, picking up two bricks and sticking them together: "This is the same as this." He pretended to swipe his finger over a glass screen. "The user is still a kid and a creator. We have a more profound understanding of the digital than we did ten years ago. Instead of panicking that the tactile toy will never survive, we realize that kids want the tactile and digital to work together. It's not discrete, it's complementary."

Nowhere is this symbiosis of digital and tactile clearer than when one scrapes the maker subculture that barnacles the hull of the Lego enterprise. In some ways it's the most exaggerated actualization of Resnick's clarion call for active players—and refutes the notion that Lego bricks lose their primacy when kids develop typical teenage interests, or that

ing. Pride of creation." "What I think is special about Lego," he said, "is this idea of structure plus freedom. You can have fun with modeling clay, but Lego provides structure. The material itself—a 2x4 brick—is freedom and structure. It's not absolute freedom: Here are the bricks, build anything. And it's not: Here are the instructions, you can only build to the specifica-

there's some predictable demographic for enthusiasts. If anything, Lego makers are fully grown adults, and the culture thrives both inside the company and out, at conventions and online fan sites and in places like the Lego Group's U.S. headquarters in Enfield, where up to two dozen model builders work to fill company requests from around the world. Among the deadlines

of the moment when I visited in the fall was a massive Lego model of the Capitol in Washington, D.C., that will be more than twenty-five feet long and will be displayed as part of the traveling Lego Americana Roadshow, which will also include a sixteen-foot Washington Monument and a sprawling White House with both East and West wings. The master builders, as they're called, are of a kind: happy to bounce between working at the computer, where they design and "concept," and building with the bricks themselves. And way more than happy to dedicate several months of their time perfecting, say, a life-size Buzz Lightyear or rakish Jack Sparrow.

"I get to be a rock star without the hassle of people knowing who I am," said Pete Donner, the design manager here, with a playful smile. His computer screen showed a koala bear that will attach to a thirty-foot Lego Christmas tree to be sent to Australia as part of a holiday show, then in what Donner called "low poly phase." He began his Lego life being into "giant gorillas, dinosaurs, and all that sci-fi stuff like robots and spaceships." Seventeen years ago, in 1997, he heard they needed extra hands at the workshop. At that time everything was analog. "People would grab a bunch of bricks and just start building," he said. By 2001, however, the switch to digital brought the use of 2D and 3D images to help the modelers. "It suddenly became more like sculpting with clay," said Donner. After eleven years of building, he was elevated to designer as well, a job he claims to be the best in the world, something you hear often among those who make their living working among Lego bricks.

"I go to Disneyland and see people—parents and kids—who are really excited about what we've built," he said. "And I get to spend my life chasing the creative urge. I used to go out on the road a lot, and, inevitably, a kid would come up to me at this or that show with the same ten bricks that sit in front of me every day, and I'd be like, 'How did you know those could go like *that*?'"

The infinite again. (Or at least the multimillionite, as it's been calculated that there are more than 900 million possible combinations for six eight-stud bricks.) "I marvel every day at how much can be done with something relatively simple," Donner said. "But you also have thousands of elements that all work together. It has transcended being a toy into something else, which is anything you want it to be."



And this is exactly what lies at the heart of what Sean Kenney—he of yellow rubber ducky—said is the maker's drive "to create something that's never been created before, just because it's a cool thing to make." Forget the cost of the sets or the corporate billions made, all the numbers and studies and thinking on it, all the people at headquarters working the spreadsheets and future plans and origin stories. This is what it always boils down to: mind, fingers, bricks. A lightning storm in the left lobe. A compulsion to build and express.

In the end it's the bricks that speak.

Kenney remembers a time when he was 20, when his mother was cleaning out his childhood bedroom. He took all of his Lego bricks back to college, and in his dorm room, with two other roommates, began building an elaborate city, mostly like the one across the river: New York. "They made fun of me for about two days," he said. He started giving himself all sorts of rules. A building couldn't be wider than it was tall, for instance. "Then when I'd return from class, I'd see they'd been playing too. There were alien invasions. Or I'd find the heads of all the minifigures in a pile, and just crack up."

▲
The Archive,
at Lego world
headquarters
in Denmark,
contains 6,141
sets, some
dating to the
1950s.

This is what it always boils down to: mind, fingers, bricks. A lightning storm in the left lobe. A compulsion to build and express.

Kenney's obsession carried through, even when he was working a six-figure office job. "I gave myself a \$200-a-month budget to spend on Legos. I made a deal with myself that I'd spend it all or lose it. If I had \$30 at the end of the month, I'd just buy a bunch of doors and windows and see what I could do with them." What he found was that there was a not-so-underground community of others exactly like him, posting their creations to the Internet, people who blew him away. One guy named Mike Doyle was building a mystical world called Odan, with a master plan calling for 200,000 Lego pieces. In order to fund part of it, he raised almost \$10,000 on Kickstarter. "He's created some unbelievably beautiful things you've never seen before," Kenney said. "It's inspiring. Some of them are like oil paintings." That, he said, is a large part of the maker movement, throwing stuff out there in hopes of moving people somehow "with the purity of interlocking bricks."

And when you delve a little, all kinds of people, it seems, are on their own interesting Lego trip. The White Stripes have a music video for "Fell in Love With a Girl," all in Lego stop-motion animation, while one of *The Guardian* website's most popular sections is called "Brick-by-brick," in which sports highlights, mostly soccer related, are re-created by stop-action Lego figures. Another maker, David Pagano, has created his own acclaimed animated franchise of "brickfilms," called *Little Guys!*, while Brendan Powell Smith has authored a book called *Assassination!* with the subtitle *The Brick Chronicle of Attempts on the Lives of Twelve U.S. Presidents*. (Its high/low point is a scene-by-scene re-creation of the Kennedy assassination, ending with Lego Kennedy grasping for a red blotch at his neck while Lego Jackie clammers to help.) On YouTube there are Lego reimaginings of everything from World War II battles (one D-Day video has over 10 million views) to cool skateboard crashes (nearly 5 million views).

So why does Lego, the name and the brick itself, lurk in the imagination, and in our lives, long after toys like the Yo-Yo Ball and Micro Machines Zbots have faded? And in an age of Xbox and PS4, in the Time of Our Digital Panoply, why are those simple bricks more popular now than ever before, racking up more than \$1 billion in profits for the Lego Group in 2013?

I wonder too: Does the answer partly lie in the work of a German artist named

Jan Vormann, whom one can find online, roaming the world, spackling holes in crumbling city walls with rainbow Lego-brick constructions? Is that the reason that Legos resonate for us—because we need rainbow patching too? Is it that life isn't this precise Pixar rendition, but blocky and striving and shape-shifting, and in the simplicity of the Lego brick we find a certain physical, intellectual, and spiritual release?

Kenney, for his part, seems to believe there is something cosmic at work. "For some of us, it's hard to imagine anything but this," he says. He holds up two Lego bricks in yellow and blue. "These are puzzle pieces, and this is how everything connects. It's like this little atomic block of the universe. Sometimes I think, what if I couldn't do this anymore? What if Lego has a CEO years from now who says we have to stop, who says we're infringing on the company's copyright? I don't know what I'd do. This has been my whole life. Would I go back and make toys? Or real houses? I don't know." Kenney grows pensive, glances at the floor-to-ceiling shelves containing his world, thousands of Lego bricks, some from his own childhood.

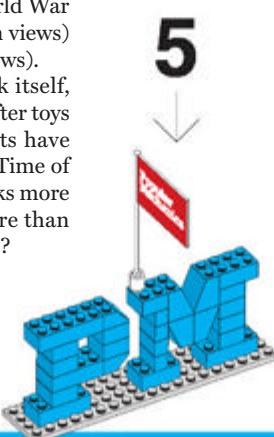
"I love slogging through all the creative problems," he says, lighting up again. "We were doing a hummingbird recently, and we were, like, three weeks behind, and I was up on a ladder building, in the thick of it again, something was squirming out here, and over here we had to lift and support and shim things.

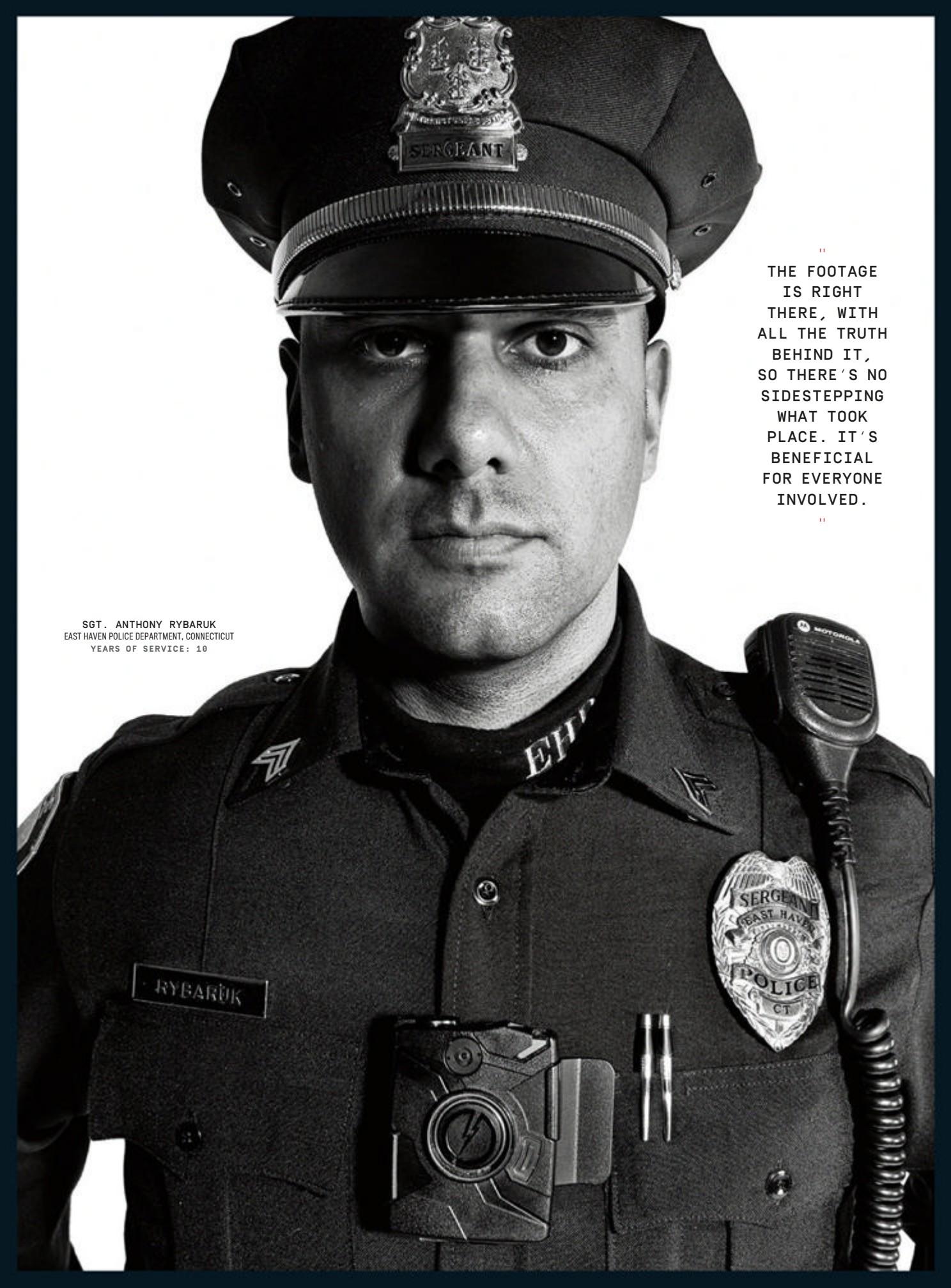
"It seems weird to say, but I was in heaven."

O, WHERE IS HE?

Right here, it turns out, behind the walnut door again, where he's always been. The time is right now, today, and my son just turned 15. Fifteen! He will soon have his driver's permit. He's interested in many things besides Lego. And yet here he is, making a Lego forest, enacting a chase scene. When I knock, he allows me in. He's happy to share what he's made, tolerates me fiddling with a few bricks as he adds to the forest. Besides the mechanical exercise of attaching brick to brick ("the interlocking principle," as Lego has it) and the unknowingness of what will happen (the thrill of discovery and invention), something else comes out of this exercise and these seemingly fugitive hours on a Saturday afternoon: I'm moved by memory and engagement into a timeless space, a place where thousands, nay, millions of other ghostly Lego-brick players already play, and where that sort of invisible interconnectedness lends its own meaning to the lopsided pterodactyl spaceship I make, the one that evokes laughter from my son and takes its place in the same world with his forest and Lego Mark Twain, with big Lego rubber ducky and Darth Vader.

But for the moment it's pretty simple. We're just playing. And the thing is this: We have no idea what might happen next. We're building a secret that we ourselves don't know yet. There are bricks in our hands, a universe. We keep building it into being. ■





THE FOOTAGE
IS RIGHT
THERE, WITH
ALL THE TRUTH
BEHIND IT,
SO THERE'S NO
SIDESTEPPING
WHAT TOOK
PLACE. IT'S
BENEFICIAL
FOR EVERYONE
INVOLVED.

SGT. ANTHONY RYBARUK
EAST HAVEN POLICE DEPARTMENT, CONNECTICUT
YEARS OF SERVICE: 10

RYBARUK



POLICE IN THE PANOPTIC AGE

04 2015

A TECHNOLOGICAL REVOLUTION IS CHANGING THE WAY AMERICAN POLICE FIGHT CRIME. DIGITAL CAMERAS LOG THEIR EVERY MOVE, AND OURS. WE DISPATCHED AN ACCLAIMED PHOTOGRAPHER TO THREE PIONEERING PRECINCTS—INCLUDING FERGUSON, MISSOURI—to CREATE PORTRAITS OF EVERYDAY COPS WEARING THE CONTROVERSIAL EQUIPMENT. THEY ARE THE FACES OF THE FUTURE OF AMERICAN LAW ENFORCEMENT.

IN 2010 THE OAKLAND, CALIFORNIA, POLICE DEPARTMENT BECAME THE FIRST LARGE POLICE FORCE IN THE COUNTRY TO WEAR BODY CAMERAS THAT RECORD EVERYTHING THE OFFICERS SEE, SAY, AND DO.

CHIEF SEAN WHENT DESCRIBES THE TRANSITION:

"There was some skepticism at first, but the officers have been won over. They really see the value in it. The cameras show that they are hardworking and do the right thing consistently. There are other factors to attribute this to as well, but over the last two years we're looking at a more than 50 percent reduction in complaints. Those complaints that do come in, we're able to resolve them a lot faster. And while occasionally we'll catch

somebody doing something they shouldn't be, the video evidence used in complaints overwhelmingly supports the police—more than 90 percent support the officer.

"It used to be that you turn on the camera when you get out of the car to walk up to the car you've pulled over. We realized that works great for your routine car stop, but it does not work if it becomes a pursuit. So now, before you even attempt to make a car stop, you turn on the camera.

"The cameras are not perfect. They show a frontal view from the direction the officer's chest is facing, but that doesn't necessarily mean the officer is looking in that direction or that he isn't talking to somebody at his side. Also, nighttime video is not great. The technology may improve, but you don't want better vision than the officer is capable of seeing either, because then there's no way to know what the officer actually saw.

"One of our major goals as a police department over the last few years has been to work on trust within the community. This is the way of the future. Law enforcement going forward has to be dedicated to some level of transparency. The public demands that, and rightfully so."

A PHOTO ESSAY BY
CHRISTOPHER
GRIFFITH



OFFICER MONIQUE COLBERT
EAST HAVEN POLICE DEPARTMENT
YEARS OF SERVICE: 13



OFFICER M. MILLER
FERGUSON POLICE DEPARTMENT, MISSOURI
YEARS OF SERVICE: 2



01



02

OFFICER W.
CATANZARO
FERGUSON POLICE DEPARTMENT
YEARS OF SERVICE: 1



01 02
04 05



03

OFFICER BRIAN
HERNANDEZ
OAKLAND POLICE DEPARTMENT
YEARS OF SERVICE: 7



04

OFFICER NAOMI
JOHNSON
OAKLAND POLICE DEPARTMENT
YEARS OF SERVICE: 6

05

OFFICER EDMUND
VECELLIO
EAST HAVEN POLICE DEPARTMENT
YEARS OF SERVICE: 23

06

OFFICER EPHRIAN
JORDAN
OAKLAND POLICE DEPARTMENT
YEARS OF SERVICE: 3



ABOUT THE CAMERAS

TWO COMPANIES DOMINATE THE WEARABLE CAMERA MARKET FOR LAW ENFORCEMENT: VIEVU AND TASER. THE OFFICERS PICTURED WEAR ONE OF THE FOLLOWING NEW MODELS AT OR NEAR THE CENTER OF THEIR CHEST.

VIEVU LE3

(USED IN OAKLAND)

This waterproof 2.8-ounce camera has a five-hour battery life and sixteen gigabytes of internal memory—enough to hold six hours of HD footage or twelve hours of standard-definition. According to Vievu, the 68-degree field of view limits image distortion and provides a closer and larger picture. In Oakland, unless it is being used in an active case, footage is currently stored for two years.

TASER AXON BODY

(USED IN EAST HAVEN AND FERGUSON)

Best known for electroshock weapons, Taser also makes this 3.5-ounce camera with 130-degree field of view to capture peripheral action. The Axon Body records only in enhanced definition (between SD and HD), and its eight gigabytes of flash memory can store up to thirteen hours of footage. This summer Taser will introduce Signal technology, which uses Bluetooth to automatically activate any nearby body camera whenever an officer's conducted electrical weapon (CEW, or taser) is turned on.

THE BACKYARD REVOLUTION



There's never been a better time to have a patch of grass to cut. We tested the market, mowing the same lawn every week from spring to fall. Read



three of the best new machines on
this before you cut another blade.



F

IRST TIME I EVER CLIMBED INTO THE SEAT OF A RIDE-ON lawn mower was the summer of 1989, working a grounds-keeping job at an industrial park near the airport. It was twenty acres, carved into parking lots, low warehouse buildings, landscaped islands, and long stretches of thick ryegrass. We used a Simplicity tractor mower—eleven-horse Briggs & Stratton, thirty-six-inch deck. Once a week, on mowing day, I'd do the whole property, Walkman in my ears, Snapple wedged next to my hip (no cup holders then), the hot black vinyl seat burning the backs of my legs. Me: cut off from the world, unavailable, thinking about nothing or everything. I'd bump along, taming the scraggly grass until it looked as close to the outfield at Fenway Park as I could get it, one thirty-six-inch strip at a time.

Took me most of a day. The back of my neck would be pink with sunburn, my ears ringing, my hair flecked with grass. Even if I hadn't finished the day's other jobs—pulling weeds in the loading docks, filling potholes with Sakrete cold patch, whatever else—the lawns were mowed, and the place looked new again.

I loved mowing day.

Today it would take half the time and be twice the fun. We live in the golden age of mowers. You have grass to cut? There are machines that steer with precision levers or a powerful wheel or a hybrid of the two. Engines that pack twenty-five horsepower, letting you fly across the backyard. High-performance blades that rotate fast enough to shear each blade as cleanly as a new razor across a whisker, even at high speeds.

Maybe it's been a while since you bought a mower. Just as today's new-car buyers are discovering all kinds of features that weren't around the last time they bought a vehicle ("It brakes by itself!"), anyone shopping for a ride-on mower this spring is in for a few pleasant surprises. Home editor Roy Berendsohn and I recently spent an entire mowing season, spring through fall, testing three very different machines, each one an exemplar of what's out there now: a traditional lawn tractor, a lever-controlled zero-turn mower, and a zero-turn with a steering wheel. Our test lawn was 26,810 square feet, about two-thirds of an acre. Even if you don't happen to be in the market for a new mower, turn the page and you'll find detailed diagrams of the new mower technology, plus advice about mowing any lawn. And if you are looking to buy, you're hitting the market at a pretty sweet moment. Either way, if you have a lawn, mowing day is approaching. Rejoice. —RYAN D'AGOSTINO

CUB CADET RZT S 46

\$2,900



We nicknamed the Cub "the Robot" for its precise movement. In some respects it's a traditional zero-turn, its drivetrain consisting of twin Hydro-Gear transaxles powering each rear wheel. Each transaxle is a hydraulic masterpiece. Power from the engine spins a fanlike impeller inside the transaxle, moving hydraulic fluid to power a gear-and-axle assembly. But unlike traditional lever-controlled

zero-turn mowers, the Cub uses a system it calls Synchro Steer: steering wheel, plus pedals for forward and reverse. We liked the setup, which allows for the easy handling of a zero-turn but the steady, predictable feel of a tractor.

Synchro Steer consists of a geared steering linkage at the front wheels, with control rods reaching back to each transmission. As you steer, the rods activate valves, sending fluid through

the transmissions. Turning the steering wheel all the way around stops one of the rear wheels, and the machine pivots on that wheel, which even spins momentarily backward. The result of this elegant engineering is fewer divots and an effortless way to reverse. The machine is also easy to use on bumps, hills, and damp grass. With a swing set, a fire pit, and other obstacles, we appreciated the Cub's maneuverability.

HORSEPOWER: 23 • **TOP SPEED:** 7 mph • **FASTEST TIME TO CUT OUR TEST PATCH:** 30 minutes • **DECK:** 46-inch, stamped 12-gauge • **WEIGHT:** 565 pounds

How to Make Your Lawn Look Like a Ballpark



Roger Bossard, head groundskeeper at Chicago's U.S. Cellular Field, joined the White Sox organization in 1967 as an assistant to his father, Gene. A ballpark is different from a lawn—most have high-tech drainage systems, and Bossard fertilizes his six times a season and measures water applications

to the drop. But homeowners, he says, should play by the same basic rules he does:

FOOD: Fertilizer drives root growth. Increased root mass translates into thick top growth that shades out weeds and cools the ground, reducing moisture loss.

WATER: Moisture dissolves nutrients so they can promote

growth. It also cools the grass through the evaporation process known as transpiration, where the grass moves water from root to blade to the air.

AIR: Running a core aerator over the turf improves oxygen exchange and moisture retention at root level. Beneficial soil microbes also flourish with the oxygen increase.

HOW TO MOW A HILL

People have been killed by riding mowers flipping over on steep grades. Here's how not to become one of those people: Read the owner's manual to find out the maximum slope at which you can safely operate the machine. If you're unsure about the slope, buy a \$12 inclinometer at a hardware store. • Up and down,



KUBOTA Z125S

\$5,780

HORSEPOWER: 25 • **TOP SPEED:** 8 mph • **FASTEST TIME TO CUT OUR TEST PATCH:** 18 minutes • **DECK:** 54-inch, fabricated 10-gauge **WEIGHT:** 771 pounds

The Z125S is part of the Kommander line, heavy-duty mowers equipped with professional-grade features like welded steel decks and commercial transmissions. It's pricey, but mow ten feet of sod and you'll see why. Being able to peel off a neatly mowed lawn in eighteen minutes is efficient (and fun). You might think mowing two-thirds of an acre that quickly would leave grass looking like it was mowed by a one-armed old lady with a chainsaw. Nope. We found the Kubota's cut to be crisp, even at high speed under demanding conditions. Case in point: Late in the season, a rainy spell kept us off the lawn for two weeks, leaving the grass tall, shaggy, and wet. Time to cut: 23:10. Result: perfect. Plus, by late fall you come to appreciate the Kubota's high seatback and knob-adjusted cut-height control. This machine is smooth, fast, and sure-footed, and it will last for decades.



THE ONE WE CAN'T WAIT TO DRIVE NEXT

John Deere's line of four-wheel-steering tractors combines coolness and functionality. A linkage system allows the rear tires to turn in concert with the wheel, reducing turning radius. This can mean an unmoved circle as tiny as six inches after a turn—impressive. The line's six models range from an 18.5-hp with a 42-inch deck (\$3,800) to a hulking full-time four-wheel-drive and four-wheel-steer model equipped with a 25.5-hp engine (\$13,700).

HUSQVARNA GT52XLSI

\$3,500



HORSEPOWER: 24 • **TOP SPEED:** 5.5 mph • **FASTEST TIME TO CUT OUR TEST PATCH:** 40 minutes • **DECK:** 52-inch, fabricated 11-gauge **WEIGHT:** 635 pounds

The Husqvarna is big and tough, with a fabricated deck welded from eleven-gauge steel, especially useful for mowing along fence rows or around big rocks, or if you maintain trails, orchards, or any place where deck-damaging debris lurks. (Our test lawn had rock walls and some nasty stones jutting out.) The Endurance V-twin engine gets its durability from full-pressure (not splash) lubrication and two-stage air filtration that ejects debris before it gets near the filter, helpful during leaf-mulching season. We also appreciated the kid-safe keyless ignition and diagnostic display, called SmartSwitch. Hop on, punch in a code, and the tractor rumbles to life. You probably won't even have to set the throttle lever, and there's no choke, although there is a cold-weather setting. Our verdict: It's a lot of machine for the money, an excellent crossover for people who mow lawns that are smooth here but tough over there.



FOR THE SMALL OF LAWN OR STOUT OF HEART

We used Craftsman's new all-wheel-drive mower equipped with a 175-cc Quiet Power Technology engine to cut smaller parts of our test area. The 92-pound mower (about \$500) has reduced noise thanks to improved blade geometry and a very good muffler. And while it may be quiet, it cuts with a vengeance.

not back and forth. • Remove obstacles (like rocks). If you can't, add landscaping around them so you can give them a wide berth. • Don't mow wet slopes. • If a slope leads to a pond, drop-off, or other hazard, stay two mower widths away. Cut the remainder with a walk mower. • Never turn on a hill. • Never let a teenager or an inexperienced operator cut on slopes.

Chicago Doctor Invents Affordable Hearing Aid Outperforms Many Higher Priced Hearing Aids

Reported by J. Page

Chicago: Board-certified physician Dr. S. Cherukuri has done it once again with his newest invention of a medical grade **ALL DIGITAL affordable hearing aid**.

This new digital hearing aid is packed with all the features of \$3,000 competitors at a mere fraction of the cost. **Now, most people with hearing loss are able to enjoy crystal clear, natural sound — in a crowd, on the phone, in the wind — without suffering through “whistling” and annoying background noise.**

New Digital Hearing Aid Outperforms Expensive Competitors

This sleek, lightweight, fully programmed hearing aid is the outgrowth of the digital revolution that is changing our world. While demand for “all things digital” caused most prices to plunge (consider DVD players and computers, which originally sold for thousands of dollars and today can be purchased for less), yet the cost of a digital medical hearing aid remains out of reach.

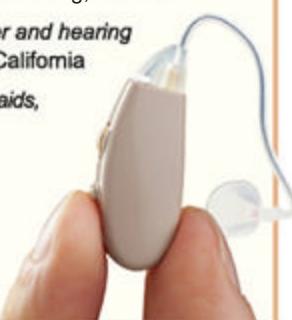
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“I am hearing things I didn’t know I was missing. Really amazing. I’m wearing them all the time” —Linda Irving, Indiana

“Almost work too well. I am a teacher and hearing much better now” —Lillian Barden, California

“I have used many expensive hearing aids, some over \$5,000. The Airs have greatly improved my enjoyment of life” —Som Y., Michigan

“I would definitely recommend them to my patients with hearing loss” —Amy S., Audiologist, Indiana



Dr. Cherukuri knew that many of his patients would benefit but couldn't afford the expense of these new digital hearing aids. Generally they are *not* covered by Medicare and most private health insurance.

The doctor evaluated all the high priced digital hearing aids on the market, broke them down to their base components, and then created his own affordable version — called the **MDHearingAid® AIR** for its virtually invisible, lightweight appearance.

Affordable Digital Technology

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The Never-Ending Fire Pit

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BY DANIEL PAUL SIMMONS III

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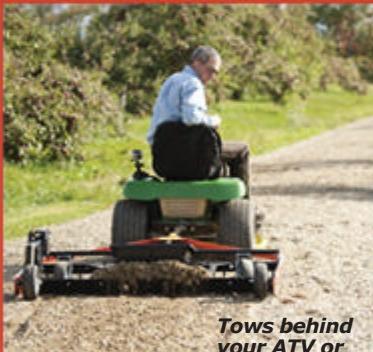
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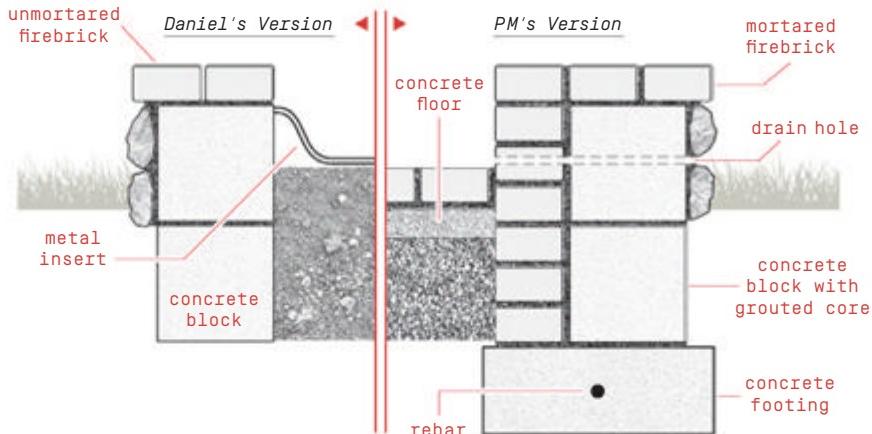
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PROJECT

THE FIRE PIT: A CROSS SECTION



WHEN A GROUP OF FRIENDS SIT AROUND A TABLE PLAYING CARDS or drinking beer, not one of them will spend hours gazing into the table itself, thinking about cowboys and friendship and human prehistory. A table does not have this power. A fire, with its meandering sparks and flame animals and depthless colors, does. An outdoor fire adds ancestral depth to a weekend in the country. In the case of the table, you have a pretty good time. In the case of the fire, you wear the same shirt to work on Monday so you can still smell the wood smoke.

My point here is that when I built a weekend cottage in Lumberland, New York, in 2009, I wanted a fire pit. I wanted to have a place where I could spend the evening sitting under the stars actually enjoying the setting in which I was paying to own a home. I also wanted more space for friends visiting from New York City, who tend to come upstate in groups, overwhelming my small house. I imagined I could construct a fire pit in a couple of weekends. In a way, I was right: Within a month we were all sitting around my new pit, watching the fire lick the sky. But then everything fell apart.

Like most weekend do-it-yourselfers, I began my research online. I looked at scores of designs, finally settling on a classic square. I also learned the first rule of fire-pit safety: choose a spot ten to thirty feet from your house, with level ground, away from overhanging trees

or power lines. I picked a location about twenty feet from my porch and the same distance from the trees. With a friend's help, I excavated a hole for the foundation. The soil on my property is as much rock as dirt, but we eventually chipped

out a 4 x 4-foot hole, about a foot deep. Daunted by the prospect of pouring concrete, I used sixteen standard concrete blocks to build the foundation.

It was completely submerged. Friends teased that I'd built the world's smallest swimming pool.

After leveling and tamping down the dirt in the hole, we arranged eight blocks in a square, which we joined with general-purpose (Type N) mortar. We laid a second level of blocks on top, mortaring as we went, then topped the foundation with one-foot-square pavers, four per side.

Over the next few weekends I applied faux stone veneer to the exterior of the blocks where they stuck up above the ground, using stone veneer mortar. The veneer I used was left over from con-

Fire Pit

struction of the cottage, but most large hardware stores sell it. When the mortar was dry, I backfilled earth around the outside walls, leaving between seven and ten inches of wall above grade.

Building the Pit

Inside the square I laid down a two-to three-inch-thick layer of multipurpose sand, then covered that with a similar layer of small rocks. Heat can deteriorate concrete blocks, so I found a local masonry supply yard that sold firebricks. I carted a couple dozen home but ran out of motivation to mortar them, so I temporarily stacked them against the inner walls.

The Problems Begin

My pride in a job well done was tempered by the next heavy rain. I had failed to take into account my yard's water absorbency, and the pit's sand-and-stone floor became completely submerged, as did the heavy octagonal grate I'd bought online. Friends teased that I'd built the world's smallest swimming pool.

After a trip to the store for more rocks to raise the floor, the pit was operational. But raising the grate brought the fire high enough to send sparks into my guests' faces. I decided I needed a mesh cover to place over the fire when it was lit. At an end-of-season sale, I discovered a premade fire pit with a black metal stand, square steel insert, and square screen cover just the right size. The cover went on the pit, and the rest of the set went into the basement.

These refinements got me through that first summer. But then I read anecdotal reports of overheated pavers in fire pits exploding. So the next spring, out came the crowbar and off came the pavers. For the rest of year two my fire pit sat unfinished, the open-topped concrete blocks filling up with rain.

During year three I bought more firebricks, experimenting with configurations to cover the tops of the blocks but never committing to any of them. Friends often kicked the bricks out of alignment (or into the fire), but I

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No-Drill MudFlaps



Drivers of trucks and SUVs are often looking for solutions to help protect their vehicle from the dirt, grime and damage of daily use. One such solution is the use of mud flaps that help protect the vehicle's fender and rocker panel. WeatherTech's No-Drill MudFlaps have once again proven to be of the highest quality and technology for vehicle protection. These MudFlaps mount in minutes without the need for wheel/tire removal or drilling; most importantly they are custom-fit for each application. Digital measurements are used to perfectly measure the needs of the vehicle to create a superior protection product.

PROJECT

still resisted the necessary mortaring.

This past summer, year four, I removed all the firebricks from the interior of the pit, and retrieved that square metal insert I had purchased with the lid from the basement. In a rare spot of luck, the insert fit the opening perfectly. I drilled several drainage holes through the metal, used high-heat rust-proofing spray paint to protect the holes, then made a makeshift rim of unmortared firebricks around the top.

The Cavalry Arrives

Nick Blohowiak, the eastern regional manager of Spec Mix, the bulk mortar division of Quikrete, agreed to review my project and give me suggestions for a rescue mission. Blohowiak comes from generations of masons and has worked in masonry himself since he was 10 years old. The first problem he noted was drainage. "I'd say you've been really lucky," he said. "Water's the most destructive force in nature, and it works against masonry when it's in contact with the ground. Eventually the water sitting in the pit and in the blocks is going to freeze, thaw, pop—and then it'll fall apart."

Blohowiak recommended filling in the blocks with masonry grout to solidify the structure, then using a core saw or large masonry bit to drill several holes, one or two inches wide, through at least two of the side walls. He said I'd probably have to rent the tools to do it. "What you're doing is allowing the water to escape," he said, "but you're also allowing cold air to roll in from the bottom—so your fires burn better." Next, he said, pour a concrete floor inside the pit, coming up to the outside ground level but below the drainage holes. And for the lining? "The right way to do this would be to use those firebricks to line the inside and the floor using a refractory mortar," Blohowiak said. "Eventually you're going to have problems with the foundation, but this'll probably help you save this thing for quite a while."

Now that it's spring, I can begin my work again. I intend to take the master mason's advice.

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How to Do It Right, From the Beginning

BY ROY BERENDSOHN

DANIEL'S FIRE PIT TURNED out all right, but if I were to take on this project, I'd build a concrete footing from the start. To do this, you want to **dig a footing hole and compact the soil** the way Daniel did, then **nail or screw together footing forms from 2 x 6 lumber**. For this project I would have recommended a square-doughnut-shaped footing. This would require two square forms, one to fit inside the other.

To fasten the form lumber, use **duplex-head nails** (a nail with a head



Simmons enjoys his fire pit and deck, which he also built.

that makes it easy to remove), or use an impact driver and Spax screws, which don't require a pilot hole. Place the footing form in the hole, and stake it in position so that its corners are square and it is level across its width and length.

Next I'd cut $\frac{3}{8}$ -inch rebar to fit into the form. The trick to using this reinforcing metal is to support it off the ground so that the concrete forms all around it. You don't want to set rebar on the ground and place concrete on top of it. You want it in the middle.

Masonry supply houses and home centers sell supports called rebar chairs for exactly this purpose. You **place the chair-supported rebar into the form and then shovel concrete into the form**, making sure that you consolidate the concrete well in the corners and around the rebar. In fact, overfill the forms slightly and slide a long piece of lumber back and forth over the form to remove the excess. This is known as screeding. The completed footing should consist of concrete that's smooth and level with the top of the form, but it should have a slightly rough texture that will help it hold the mortar for the first row of concrete block. Let the concrete cure, at least overnight, then remove the footing forms.

Now you can take Blohowiak's advice. **Build up a square of eight concrete blocks on the footing, filling them with masonry grout** and joining them with general-purpose mortar. Do the same with another level of

blocks. Affix stone veneer to the exterior, where it rises above the ground. **Lay down a three-inch-thick layer of crushed stone inside the pit, and then pour a $3\frac{1}{2}$ -inch-thick concrete floor. Line the inside and floor with firebricks and refractory mortar, then drill a drain hole through the side** (see diagram, page 96) using a core saw or masonry bit. Finally, **mortar firebricks along the top**. Keep the masonry moist with a plastic tarp or piece of wet burlap for at least a week before lighting a fire.

PHOTOGRAPH BY ZACH DESART

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60457/69197

Item 2707 shown

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62517

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HOW MANY MIRACLES DO YOU NEED TO BECOME A BELIEVER WHEN YOU ARE TOLD THEY ARE SCIENTIFICALLY IMPOSSIBLE?

Miracles are always a work in progress that begin with one step. In the 19th century the quest for the purest water began with Michael Faraday's First and Second Laws of Electrolysis. But hypothesizing a law mathematically is not the same as actually achieving the results. Stepping into Faraday's shoes some 40 years ago was Electrical Engineer John Ellis who succeeded in doing what no inventor has done before or since—he perfected the distillation and purification of water—altering the bond angle of the hydrogen in the water from 104° to 114° creating what a Washington Post writer referred to in 1992 as "light water" and what most simply call "miracle water."

I started a scientific controversy when I finally changed the properties of ordinary water into "MIRACLE WATER" by increasing the Hydrogen Bond Angle in ordinary water from 104° to a measurable 114° and maintained it! However, text books will tell you this is "IMPOSSIBLE" because like any substance, as a result of that change it's not water anymore, it's something else but if you are a believer you know with God anything is possible!! Scientists have said for years that if anyone could do that it would "Cure Anything" and at 85, after being in this family business for 40 years, we have thousands of reports that it HAS!! Even during the development stage, as far back as 1/27/92 a Washington Post Investigative article (on my website) noted 10,000 people/day travelling to obtain my water! Do I want everyone to use my water? The short answer is NO because Bill Gates and many others have said we have to depopulate the planet down to 500 million (only those people that believe in God's miracles will survive)!

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HERE'S PROOF why they say it's "impossible": Jon Spokes at The Washington Times received a phone call from the top scientist at the Los Alamos Nuclear Lab with so many degrees after his name he needed a fold out calling card: "You have a scam artist advertising the

impossible in your newspaper!!" which was followed by scientists from Lawrence Livermore and the Fort Detrick Biological and Cancer Institute. Jon Spokes monitors advertisers for honesty to maintain the good name of the newspaper! Accordingly, he told him: "Call John and if you decide he's a scam artist, he will never advertise in this newspaper again!" After calling me and buying our E5 machine, he laughingly told Jon: "I am embarrassed to say John HAS CHANGED THE HYDROGEN BOND ANGLE in water and I wish I owned his patents!" Since that time we have sold 100's of machines to these scientists that include Lawrence Livermore and Brookhaven Labs when a nuclear reactor contaminated an aquifer. With an Engineering Degree that includes Steam Plant Design, God proved with his infinite wisdom that I was right and the textbooks were WRONG!

After the above article, G. Abraham MD did independent Blood Flow studies at UCLA Medical School since blood is 94% water: "You can't argue with something you can measure. Nothing is even close to your water in getting blood to the extremities!" However, charlatans have bought my machines and used my "Miracle Water" on religious TV and since we can measure the 114° HBA we can see if it's our misbranded water! In some cases, it tests out as tap water!! Also, BOTH ordinary distilled (101° HBA) and ordinary water (104° HBA) have ZERO ENERGY!! Our 114° HBA water has 3000% MORE ENERGY and we can measure that also (website Ammeter Video adding ONLY 20 DROPS to ordinary water)! 94 year old Gilbert de Daunant (Prince Rainier's cousin), after shipping a machine to an MD in Africa: "Your water is working against EBOLA both in and out of the hospitals!" Since this energy boosts the immune system, we want to reach as many people as possible as a humanitarian effort. Accordingly, I am putting my properties into a nonprofit and using TV for further outreach. Our gorgeous 418 acre mountain property overlooking the Delaware River is perfect to evangelize this discovery! With its one of a kind Gatehouse and Pavilion including miles of roads with estate lighting and underground utilities to protect the visual beauty, this is a unique setting for visitors. We hope you will join us! 13 Patents 332 FDA Tests. Johnellis.com/measure • Written by John Ellis

Gilbert de Daunant (Prince Rainier's cousin): "I just walked 40 blocks and I am 94! Send another E5 to Monaco!"

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WIND-UP DRAGSTER

A project to build with your children. DESIGNED BY ROY BERENDSOHN



Materials

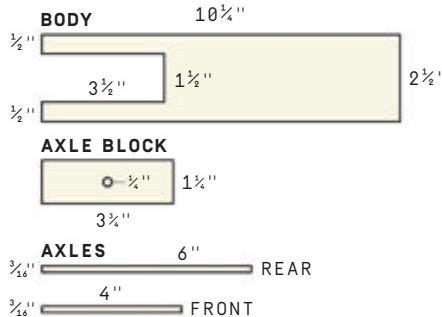
QTY.	DESCRIPTION
1	1/4 x 2 1/2 x 24-inch poplar block
1	Package 1/2L beveled washers
1	1 1/2-inch-diameter birch tread wheel
1	Package (two pieces) 1/2-inch brass cup hooks
1	1/2-inch plastic barbed irrigation fitting
1	3/16 x 48-inch poplar dowel rod
3	Sticks of hot-melt glue
1	10-inch rubber band
4	Old compact discs
1	Jumbo paper clip

Instructions

- 1. Mark the outline of the car body (see right) on the poplar block. Using a $\frac{3}{8}$ -inch bit, drill two holes at the interior corners of the U-shaped rear axle cutout. Use a jigsaw to make a parallel cut to each hole. Cut between the holes to form the U.
- 2. Rip and crosscut the two blocks that will support the rear axle. Make diagonal marks on one of the blocks to find the center, then clamp both to the workbench and bore a $\frac{1}{4}$ -inch hole through the center mark.
- 3. Cut two dowel rods to length with cutting pliers. Clamp the birch wheel and drill two small holes in its side with a $\frac{3}{64}$ -inch bit. Chop the end off a paper clip with pliers, then insert the remaining U-shaped piece into the

holes and secure with hot glue.

- 4. Twist the cup hook into the bottom of the car body, 2 $\frac{1}{2}$ inches back from the front. On the opposite side, 1 inch back from the front edge, affix the irrigation tube to the body with hot glue.
- 5. Attach the rear axle blocks to the body with hot glue. Push the axle through one block, then slide on a beveled washer, the birch wheel, and another washer. Push the axle out through the opposite block, center the wheel, and affix it with hot glue.
- 6. Slide the front axle through the axle tube and add beveled washers to either side.
- 7. Affix the flat side of a beveled washer to each CD wheel with hot glue, then reinforce the seal by covering it with a dome of glue, being careful not to block the axle hole.



- 8. After the glue cools, press the wheels onto the axles.
- 9. Loop one end of the rubber band through the paper clip winder on the birch wheel and place the other over the cup hook. Rotate the wheels backwards to wind the rubber band, place the racer on the floor, and let it go.

● parent only ● kid only ● parent and kid

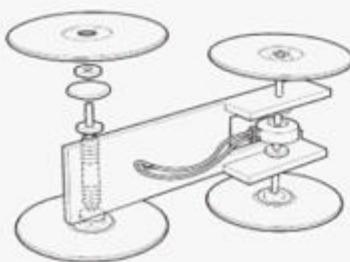


A project to build
with your children.
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WIND-UP DRAGSTER



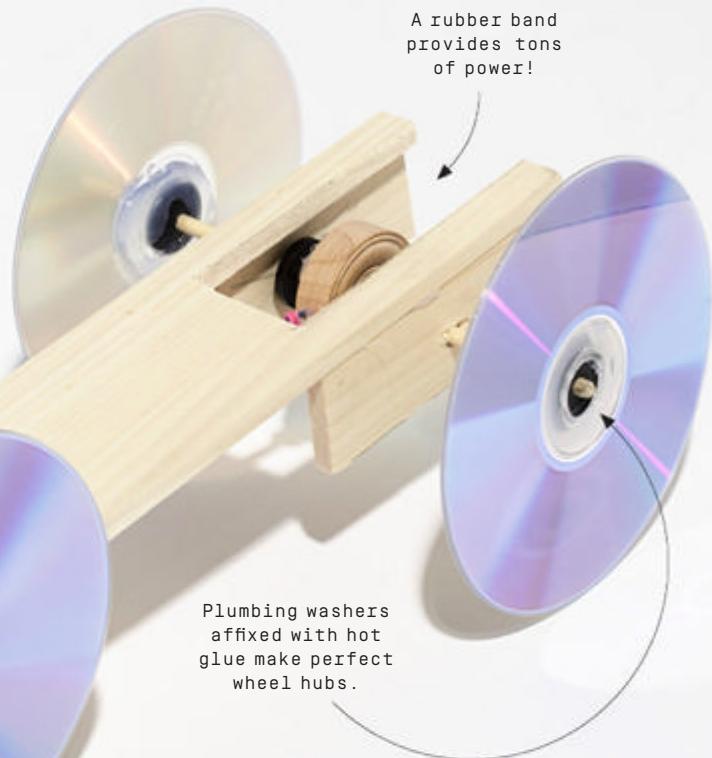
The axle tube is an irrigation coupler.



WE BUILT THE FIRST PROTOTYPES OF this rubber band powered dragster using wood glue and Super Glue, but they took too long to dry, and the bonds weren't solid enough. A kid's toy needs to be durable, so we decided to use hot glue. You don't have to wait for it to dry, and it's superstrong.

To make the wheels even stronger, we added a step to the process: a generous glob of hot glue over the washer/wheel hub. That should keep the hub from popping off in most situations, but if you really want tough construction, try making the axle out of a bolt, washer, and nuts.

Our initial thought for powering the racer was to use a mousetrap, with one end of the string looped around the driveshaft and the other tied to the trap's hammer. But a mouse-



PROJECT NOTES

trap isn't the safest component to be playing with, whether you're a kid or an adult, so we switched to a rubber band. In early tests the rubber band was affixed to both ends of the system—the cup hook and the wheel. It took only one test run to learn that you want the rubber band to drop off as soon as its tension is completely released, otherwise it stops the car from going forward. Depending on the size of your rubber band, you'll want to adjust the position of the cup hook accordingly.

And finally, we learned that with any project with kids—especially one involving drilling and cutting—you want an expendable work surface. Even laying a piece of plywood or masonite over your existing workbench would work great. You won't mind when it's cut into or drilled through, and you can focus on the actual construction.



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THE NEWLY REFINED
2016 MAZDA CX-5

The interior of the Mazda CX-5 is a sight to behold. With its beautifully crafted cabin and available MAZDA CONNECT™ infotainment system,¹ you're always in touch with your world. And with Facebook, Twitter and Pandora® Internet radio at your fingertips, you may never want to leave. This is the Mazda CX-5.

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